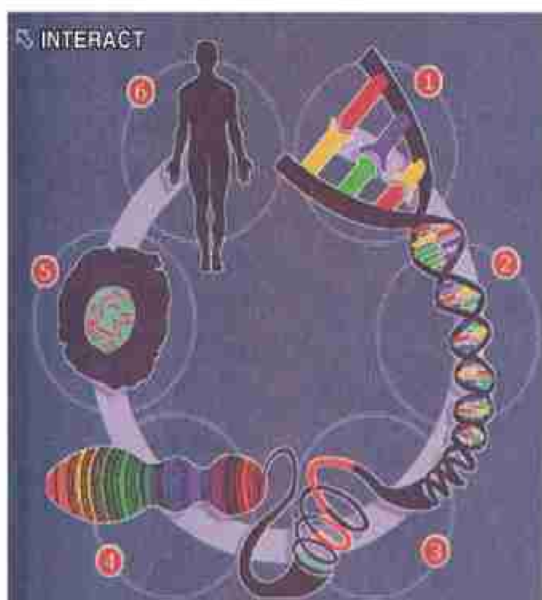


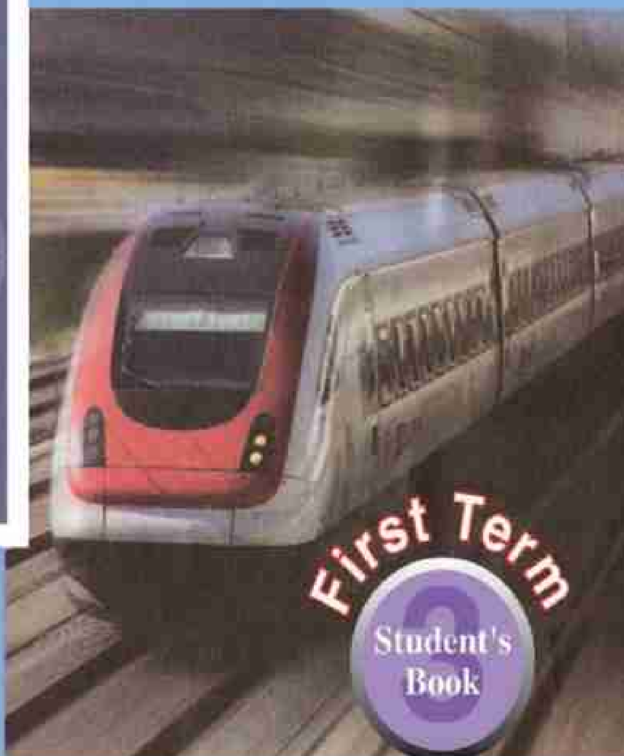
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Science and Life

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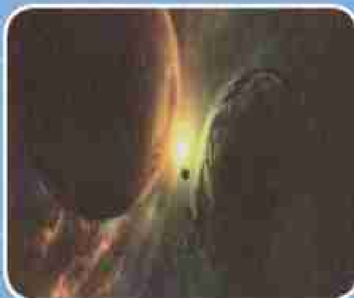




2021 - 2022

غير مصرح بتداول هذا الكتاب خارج
وزارة التربية والتعليم والتعليم الفنى







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Introduction

This book is considered a cornerstone in the second preparatory developed science curriculum, that achieves the objectives of developing curricula in order to cope with the 21st century.

Our curriculum aims to achieve the following educational directions:

- Highlighting the relation between Science and Technology in the science domain and its reflection on the development process.
- Emphasizing the suitable situations that distinguish the effect of the scientific and technological progress in producing knowledge.
- Emphasizing students practicing their active and conscious behaviour toward using the technological outcomes.
- Emphasizing students ability in the scientific thinking methodology, then the possibility for them to move from learning depending on receiving knowledge to learning depending on self-learning in an atmosphere of joy and amusement.
- Students depending on exploring to reach information and gain much experiences through developing the essential thinking skills such as observation, analysis, concluding and reasoning.
- Providing opportunities to students for practicing citizenship through the methods of self-learning and the team work spirit, negotiating and confessing, accepting others and rejecting extremists.
- Enriching students with various life skills, and the practical capabilities through increasing all interests in the practical and scientific domain.

This book contains four integrated units, each one contains a set of integrated lessons achieving the concerned objectives.

We hope that this book may benefit our sons for the favour of our country Egypt.

Preparation Team

CONTENTS

Unit 1: Force and Motion



Unit 2: Light Energy (Mirrors and Lenses)



Unit 3: The Universe and the Solar System



Unit 4: Reproduction and Species Continuity



Safety in Science

Scientists know that they must work safely when doing experiments. You need to be careful when doing experiments too. Here are some safety tips to remember.

Safety Tips

- ✔ Read the steps of each experiment carefully.
- ✔ Wear safety goggles when needed.
- ✔ Clean up spills right away.
- ✔ Never taste or smell substances unless directed to do so by your teacher.
- ✔ Handle sharp items carefully.
- ✔ Tape sharp edges of materials.
- ✔ Handle thermometers carefully.
- ✔ Use chemicals carefully.
- ✔ Dispose of chemicals properly.
- ✔ Put materials away after you finish an experiment.
- ✔ Wash your hands after each experiment.



The first term - Unit one

Force and Motion



Introduction

In 1964, Japan operated the first fast electric train. The speed of this train reaches 200 kilometers / hour. This train was developed afterwards so that its speed reached 270 kilometers / hour, and it was named " The Bullet Train ". The difference between this " bullet train " and other trains is that each of its carts is operated by an engine of its own. In this way, the train can move at extreme speeds more than the train that consists of a chain of carts pulled by one engine. The " bullet train " can move at an increasing velocity not a decreasing one.



UNIT OBJECTIVES

By the end of this unit, students should be able to :

- ✔ Describe motion and mention its types.
- ✔ Identify physical quantities necessary to describe the movement of objects.
- ✔ Link motion's laws to real life situations.
- ✔ Acquire mental skills in solving examples and problems on motion's law.
- ✔ Represent uniform speed graphically.
- ✔ Calculate the average speed of a moving object.
- ✔ Identify the concept of relative speed.
- ✔ Identify the concept of acceleration.
- ✔ Mention examples of some standards and vectors as physical quantities,.



Included issues

- Safety and security.



Lesson 1
Motion in one direction



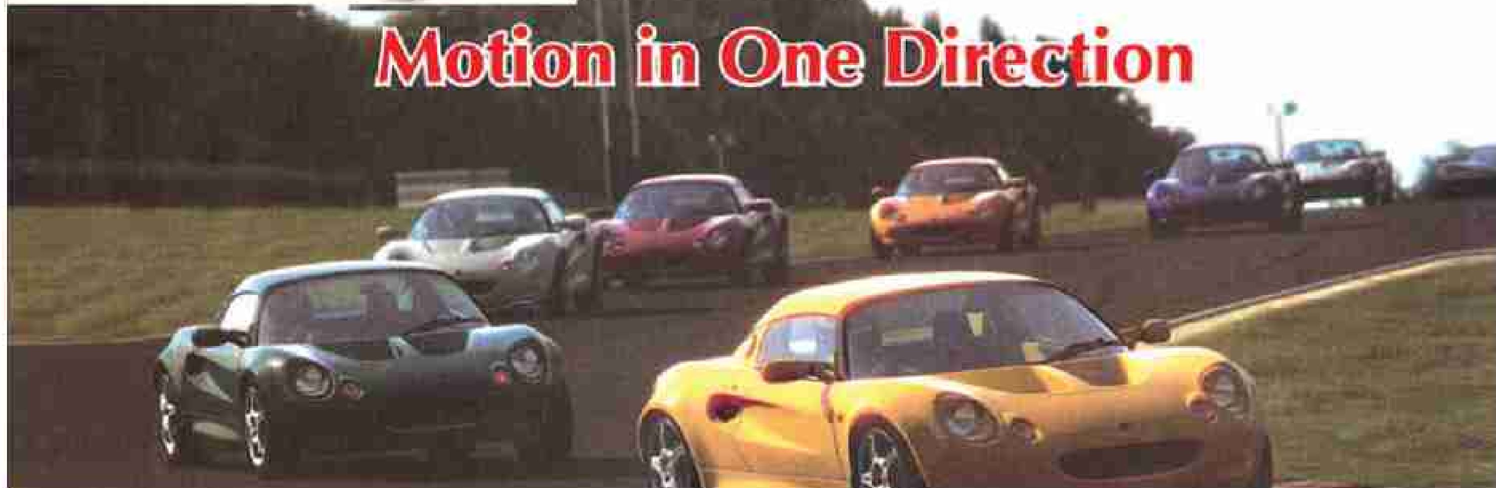
Lesson 2
Graphic representation of the motion in a straight line



Lesson 3
Physical quantities scalars and vectors

Lesson 1

Motion in One Direction





Lesson objectives

By the end of this lesson, students should be able to:

- Describe motion identifying distance, time and speed.
- Distinguish between regular motion and irregular motion.
- Identify the concepts of uniform speed, irregular speed and average speed.
- Calculate the constant uniform speed of a moving object.
- Use the mathematical relation in calculating the average speed of amoving body.
- Identify the concept of relative speed.



Lesson terms

- Regular speed.
- Average speed.
- Relative speed.

The concept of motion is linked to the change of an object's Position as time passes according to the Position of another object. To simplify the concept of motion, we only assume that the motion occurred in one direction such as the movement of the metro or train on rails is an example of moving in one direction. In this movement, the train moves forward or backward but it does not move upward or downward. Its path may be straight, curving or a combination of both. If the movement' path is straight, **It Is Called Straight Line Motion Which Represents The Simplest type of Motion**



Figure (1): Metro movement is an example of one direction movement

Speed

In our daily life, the motion of object is described as fast or slow. To compere between the two concepts the term "speed" is used.

Example:

- If two cars – black car and white car – move on the same road (path,) the black car takes a time (t_1) in covering this path while the white car takes time (t_2).
- If the time span (t_1 second) is less than the time span (t_2 second), which one of these two cars is faster



as in figure (2) which one of the two cars is faster ? why ?

Why?

....

....

If the two cars move in two paths of different lengths,

- **If the path length of the black car is (d1 meter) and that of the white car is (d2 meter) which is shorter than d1.**
- If the two cars cover the two paths at the same time span although d_1 is longer than d_2.
- Which one of the two cars is faster ?

Why?

....

Conclude: What are the two factors necessary for the movement description

1. ....
2. ....

We can conclude that the length and the time are the two basic factors necessary to describe the movement. Based on these two factors, we can identify a physical quantity called "speed".

Speed: it is the distance moved through a unit time.

If an object covers a distance (Δd) with a short time span (Δt), the object's speed (v) during this time is

$$\text{speed} = \frac{\text{distance}}{\text{time}} \quad \text{i.e.} \quad V = \frac{\Delta d}{\Delta t}$$

Uniform speed

Cars and planes are usually provided with a group of counters as speedometer, mileage, hour timer and compass.

The speedometer helps us in identifying the speed of the car directly. If the speedometer's pointer points to 72, this means that the car's speed is 72 kilometer/hour which is approximately 20 meters/second. If this reading stays constant during travel, we say that the car moves at regular (uniform) speed. This means that the car covers **equal distances in equal periods of time.**

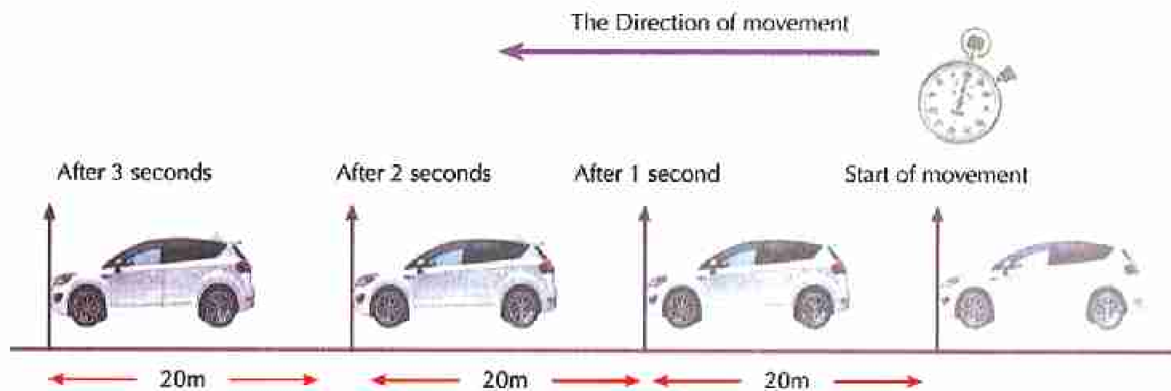


▲ Figure (3): Speedometers

Speed is measured in meter / second (m/s), when distance is measured in meter and time is measured in second. It is also measured in kilometer / hour (km/h), when distance is measured in kilometer and time is measured in hour (as in the case of cars, trains, planes and ships, ...)

when the time equals 1 second and the distance is 1 meter, so the speed $= \frac{\text{distance}}{\text{time}} = 1\text{m/sec}$

The following figure represents a car moving in a straight road



▲ Figure (4): The car moves at a regular speed

Study this figure and answer the following questions:

- What is the distance coveres by the car in each second?
- Does the car cover equal distances in equal periods of time? (Yes / No)
- What is the speed of the car? ....meter / second.
- Does the car move at regular (uniform) speed? (Yes / No)

Generally, when the movement is at regular speed, the moving object covers equal distances at equal periods of times whether the distance and time are short.

This means that $V = \frac{d}{t}$ **for regular speed only**

Where (d) is the distance moved during a period of time (t).

Irregular speed – average speed

It is hard to measure regular speed practically. If we observe of a car moving on a road, we find that its speed changes according to traffic; it does not stay constant. In this case the movement of the car is described as «movement at irregular speed».

In this case, it is useful to refer to another term which is the average speed ($\overline{V}$) known as the total distance that a moving object covers divided by the total time taken to cover this distance. This means that:



▲ Figure (5): The car's speed changes according to traffic.

$$\text{Average speed}(\overline{V}) = \frac{\text{total distance covered}}{\text{total time}}$$

In symbols it is

$$\overline{V} = \frac{d}{t}$$

Question for thinking

- What is the thing that moves at constant speed in space?

- Average speed represents the regular speed by which the object moves to cover equal distances at same period of time.
- When the objects moves with a uniform speed, the average speed of the object = its unifrom speed ($V = \overline{V}$),

- **The speed is called non uniform** when the object covers equal distances at unequal of periods of time or covers unequal distances at equal periods of time.

solved Example :

A runner covered a distance of 100 meters of a straight track in 10 seconds. Then, he returned back walking. He took 80 seconds to come back to the starting point of running.

The racer's average speed while running is calculated by this relation:

$$\bar{V} = \frac{d}{t} = \frac{100}{10} = 10 \text{ meter / second}$$

His average speed while returning is:

$$\bar{V} = \frac{d}{t} = \frac{100}{80} = 1.25 \text{ meter / second}$$

The racer's average speed during the whole trip is:

$$\bar{V} = \frac{d}{t} = \frac{200}{90} = 2.22 \text{ meter / second}$$



▲ Figure (6): Arunner in a 100 meters race.

Relative speed

If there is a person in a car that moves at 80 kilometers in a certain direction. Then, a car moves at 90 kilometers passed him in the same direction. This means that if there is a person standing on the side of the road and he observes the speed of the moving cars (this person is called the observer).

Therefore:

- The speed of the slow car relative to the observer standing on the ground = 80 kilometers /hour
- The speed of the fast car relative to the observer standing on the ground = 90 kilometers/ hour.
- As for the fast car relative to the passenger in the slow car is 10 kilometers/hour
- Does the value of the car's speed differ in relative to the change in the observer's position? (Yes / No)



▲ Figure (7): The relative speed

Therefore,

Measuring speeds depends on the position of the observer who determines the magnitude of this speed. This means that relative speed is the speed of the moving object relative to the observer.

We can conclude that:

The value of the car's speed relative to the observer standing on the ground differs from the value of the car's speed relative to an observer in another moving car. So, the relative speed depends on the position of the observer. this means that the relative speed is a speed of the moving object relative to the observer.

Lesson 1 exercises

1 Define the following:

a) Uniform speed.
b) Average speed.

2 Write a suitable word to complete the following sentences:

a) The result of multiplying a speed of a moving object by time = ...
b) .... is defined as the covered distance within a unit time.
c) Speed measurement units are .... or ....
d) The result of dividing the total distance that a moving object covers by the total time taken to cover this distance = ...

3 Write the scientific term that corresponds to each of the following statements:

a) The distance that a moving object covers within a unit time.
b) A moving object covers equal distances at equal periods of time.
c) The total distance that a moving object covers divided by the total time taken to cover this distance.
d) The value of an object's speed relative to the observer.

4 What is meant by each of the following:

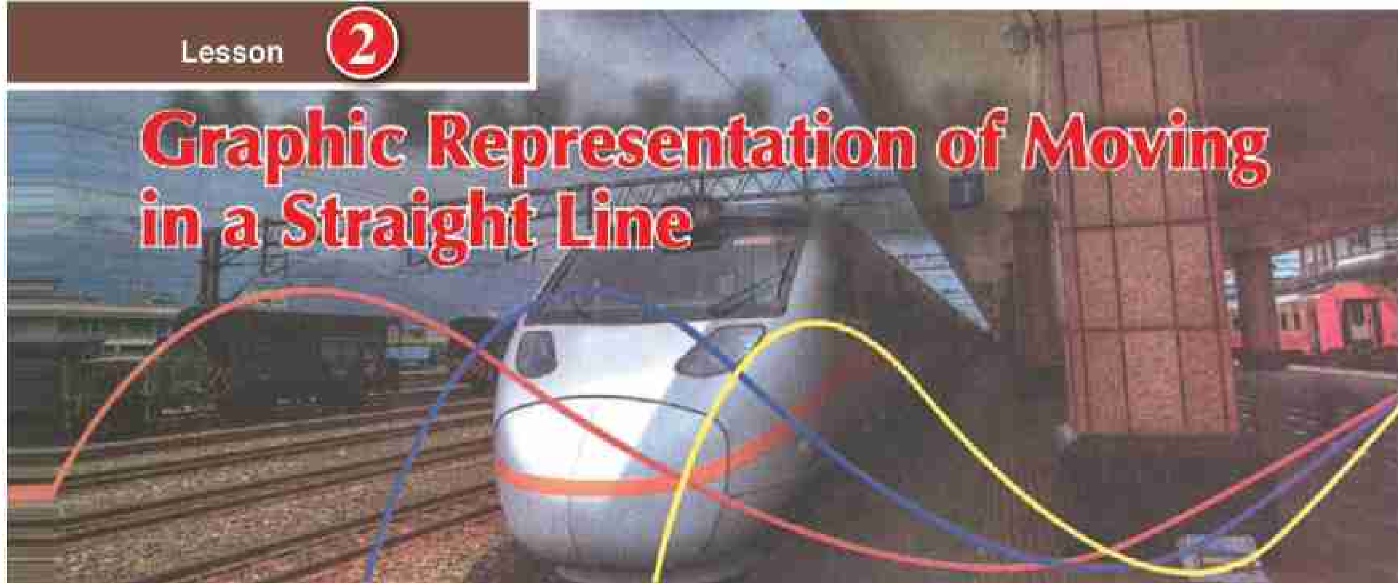
a) The average speed of a moving car is 70 kms/hour.
b) A car moving at a uniform speed = 80 kms/hour.
c) A moving car covers a distance of 100 kilometers in two hours.
d) An object moving in a straight line, covers a distance of 20 meters in one second.

5 A boy on a bike covers 300 meters in a minute and 420 meters in the next minute. Calculate its average speed:

a) During the first minute
b) During the second minute
c) Within the two minutes.

Lesson 2

Graphic Representation of Moving in a Straight Line

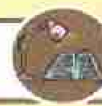




Lesson objectives

By the end of this lesson, students should be able to:

- ✔ Draw the graphic relation (distance - time) of a moving object at regular speed.
- ✔ Draw the graphic relation (speed - time) of moving object at irregular speed.
- ✔ Identify the concept of acceleration.
- ✔ Distinguish between increasing and decreasing accelerations.



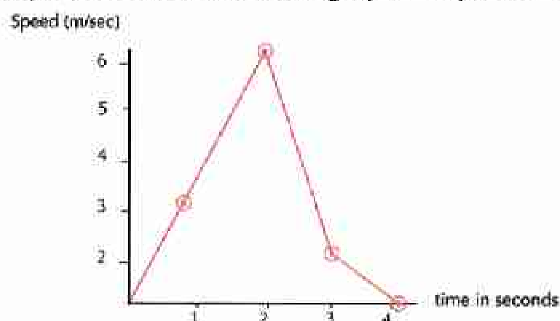
Lesson terms

- Acceleration.

To understand many of the physical phenomena, mathematicians use mathematical relations between different variables to describe a specific phenomenon. As for physicists, they use mathematical methods like graphs and tables to predict the relation between certain physical quantities, understand practical results and describe the physical phenomena in an easier way.

For example, graphics can possibly represent the relation between the speed and time of a moving car.

If the car starts to move from rest (speed = zero) and after one second its speed becomes 2 m/sec. After another second, its speed increases to 5 m/sec. Then, the motorist had to use the brakes to slow down the car's speed to 1 m/sec in the third second and he stops completely after another second. It is possible to represent the movement graphically as the following:



▲ Figure (8): The graphic relationship (Speed - Time) of a car motion.



Representing the uniform speed graphically

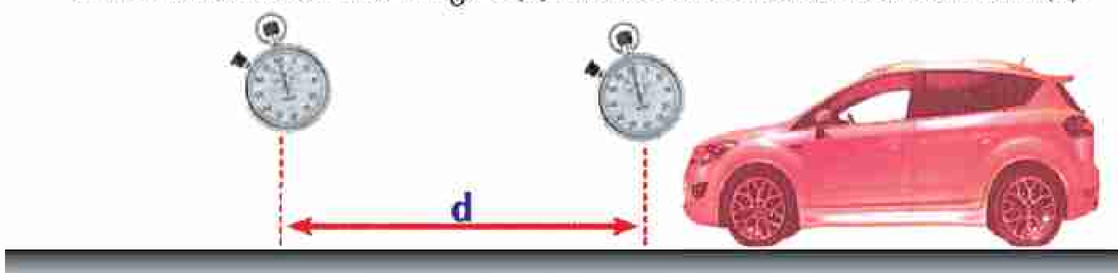
Tools:

A toy car operated by a battery – smooth wooden board of about 2 meters length – a metric ruler or metric strip – stop watch

Procedures:

Collaborate with your classmates to do the following activity:

1. Place the wooden board at a horizontal position. Put two marks at a certain distance on the wooden board as in figure (9). Measure the distance between them (d).



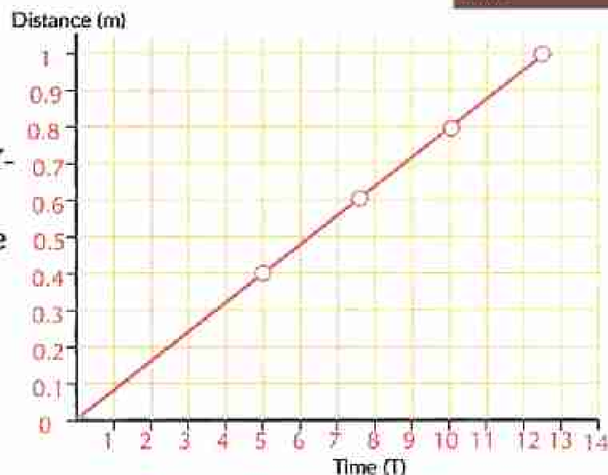
▲ Figure (9) The relation between distance and time

2. Operate the car, and during that, another student measures the time (t) taken to cover this distance.
3. A third student repeats the experiment changing the two marks.
4. Exchange the tools with your colleagues and repeat the experiment.
5. Write the results in a table.
6. In each time, calculate the speed of the car from the relation: V= d/t.

The following table illustrates some readings that a group of students made:

The number of trial	The covered distance (d) meter	The time taken to cover the distance (t) second	The speed V = d/t m/s
1	0.4	5	0.08
2	0.6	7.5	0.08
3	0.8	10	0.08
4	1.0	12.5	0.08

To illustrate the relation between distance (d) and time (t), we can draw a graph of the measured quantities. We use the distance (d) on the vertical axis (Y-axis) and time on the horizontal axis (X-axis) as in figure (10). Then, we place the readings in the table in the shape of dots. When we join these dots together, we find that they are located on a straight line passing the intersection point of the two axes. (the origin point).The resulting graphic line represents the car motion



▲ Figure (10): The graphic relationship (distance – time) of a car moving at a constant speed

Study the previous (distance - time) graph and conclude:

What is the proportional relation between distance (d) and time (t)?

Does the car move at a uniform speed? (Yes/No)

If we draw the relation between the speed (V) and time (t), we get a graphical relation as shown in figure 11.

Use the previous table to draw the graphical relation between the speed(V) and the time (t) which represents the car motion its a regular speed.



▲ Figure (11): the (Speed – Time) graph for a car moving at constant speed (uniform speed)

Study the previous relationship and conclude:

What is the value of the uniform speed of the car? .... meter/second

From the previous activity, some facts are clarified about the regular movement in a straight line.

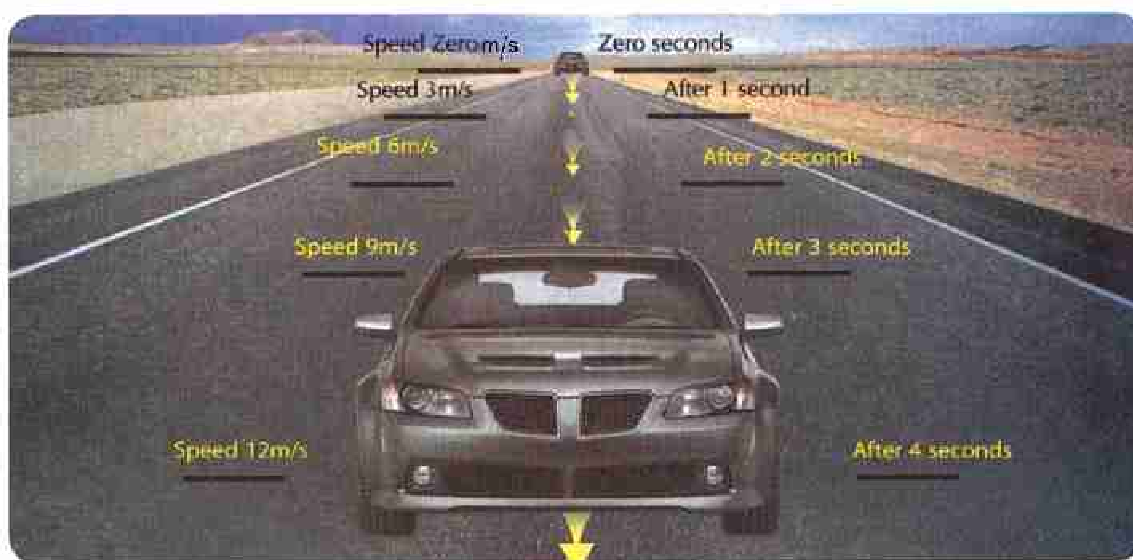
1. The (distance – time) graph for regular motion at constant (uniform) speed is represented by a straight line passing through the origin point.
2. The (speed – time) graph for regular motion at constant (uniform) speed is represented by a straight line parallel to the time axis.

What is the concept of acceleration?

If you sit in a car next to the driver and the car starts moving from rest on a straight road, you notice that the car's speed increases by time. So, after a second the speed equals 3 meters/second.

After two seconds, the speed is 6 meters/second and after three seconds the speed becomes 9 meters/secondAfter four seconds, the speed becomes 12 meters/second.

To describe the movement of the car in this case, we use a physical quantity that expresses the change in the car's speed in one second. We call it "acceleration" As shown in figure (12), the car's speed increases at a constant rate (in a speci fic direction) and in this case the movement is described as "accelerating motion". But, if the car's speed decreases each second until it stops, the movement is described as deceleration . Acceleration is the result of dividing the change in the car's speed (Δ V) by the time (Δ t) in which the change occurs.



▲ Figure (12): What is the value of acceleration that the car move with?

$$\text{Acceleration (a)} = \frac{\text{Change in speed } (\Delta V)}{\text{Time } (\Delta t) \text{ in which change occurs}}$$

The change is represented by the symbol : Δ (delta)

This means that:

$$\text{Acceleration (a)} = \frac{\text{Final speed } (V_2) - \text{initial speed } (V_1)}{\text{Time } (\Delta t)}$$

What is the measurement unit of acceleration?

We previously learnt that the speed measurement unit is meter/second and that time measurement unit is second.

$$\therefore \text{Acceleration units} = \frac{\text{Speed units}}{\text{Time units}} = \frac{\frac{\text{Meter}}{\text{second}}}{\text{Second}} = \text{meter/second}^2$$

- In the previously mentioned example, acceleration is = $\frac{V_2 - V_1}{t} = \frac{12 - \text{Zero}}{4} = 3$ meters / second^2
- If the object's speed increases by time, it is called acceleration.
- If the object's speed decreases by time, it is called deceleration.

This means that acceleration is the value of change of an object's speed in one second.

Question for thinking

- A car whose movement starts from rest and then its speed increases to 15 m/ sec through 5 seconds.
- Another car whose movement starts from rest and then its speed increases to 20 m/sec through 10 seconds.
- Which of the two cars is moving at greater acceleration?

Exercise: uniform acceleration

Assume that an object starts its movement from rest and in a straight line and assume that we record its speed every five seconds as in the following table:

Time (t) second	Speed (V) meters/second
0	0
5	10
10	20
15	30
20	40
25	50
30	60

What do you notice in the table?

Does the object's speed increase regularly during movement? (Yes /No)

What is the value of increase in the object's speed every five seconds? ....

Calculate the value of increase in the object's speed every second? ....

What is the value of the object's acceleration during this time(30 S.)? ....

In this case, we say that the object moves at a uniform acceleration. Uniform acceleration means that the object's speed changes (increases or decreases) by equal values through equal periods of time.

Example:



▲ Figure (13): A bus moving in a straight line .

On a straight line there is a moving bus whose speed changes from 6 meters/second to 12 meters/second during a period of three seconds, what is the value of acceleration?

Initial speed = V_1 = ... m/s

Final speed = V_2 = ... m/s

Time = ... s.

Acceleration = $\frac{V_2 - V_1}{t} = \frac{\dots - \dots}{\dots - \dots}$

= .... m/s^2

Lesson 2 exercises

1 **Put a (✔) in front of the correct answer:**

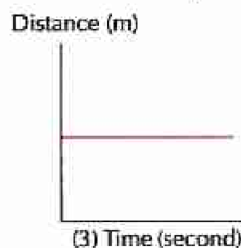
(a) Acceleration is:

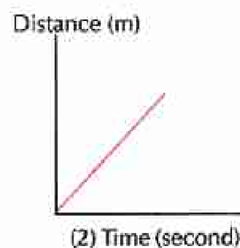
1 Change in distance in unit time.
2 Change in speed in unit time.
3 Rate of change of distance relative to the speed.

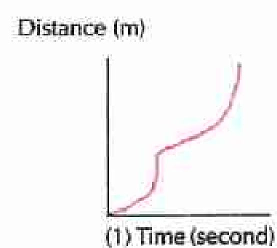
(b) Movement is at uniform acceleration:

1 If the object's speed changes at equal values in equal time intervals.
2 If the distance that the object covers changes at equal values in equal time intervals.
3 If the average speed equals the regular speed.

(c) Which of the following graphs represents the movement of an object at constant speed?







2 **If an object moves from rest regularly until its speed reaches 10 meters/second after two seconds from the start of moving, so,**

(a) The change of speed through two seconds = ------------------m/s
(b) The change of speed through one second = ------------------m/s
(c) Acceleration = -------------- m/s^2

3 **On recording the results of an experiment in which an object moves, the results were as follows:**

Distance (meter)	10	20	30
Time (second)	1	2	3

This object moves at:

1- Uniform deceleration.
2- Uniform acceleration.
3- Uniform speed.

Lesson 3

Physical quantities; scalars and vectors





Lesson objectives

By the end of this lesson, students should be able to:

- ✔ Identify the concept of physical quantities.
- ✔ Mention examples of some standards and vectors physical quantities.
- ✔ Compare between distance and displacement.
- ✔ Identify the concept of a velocity



Lesson terms

- Standards physical quantities.
- Vectors physical quantities.
- Displacement.
- Velocity.

The description and interpretation of physical phenomena represent the greatest part of physics. To understand these phenomena, it is necessary to deal with physical quantities and mathematical relationships. Each physical quantity is related with a measurment unit that characteristic to it Examples of physical quantities are: mass – length – time – force – **Velocity - displacement - acceleration**



▲ Figure (14): Time is an example of physical quantities

Mention other examples of physical quantities:

.... , ... ,
.... , ...

All physical quantities are classified into two types:

1. Scalars.
2. Vectors.

What are the Scalar's physical quantities

To define the scalar physical quantity, it is enough to identify its magnitude only by giving its numeric value and measurement unit.

Examples of scalar's physical quantities are mass (measured by kilogram), length (measured by meter) and time (measured by second).



▲ Figure (15): Length and mass are examples of scalars

This means that the scalar quantity is the quantity that has magnitude only and it has no direction.

Mention some other examples of scalars:

.... ، .... ، ....

Why are these scalars?

....

Information

Enriching information

- All scalars are subject to algebraic mathematical operations related to numbers and specially they are added and subtracted if they have the same measurement units.

What are vector physical quantities?

To define vectors, it is not enough to identify their magnitudes only by giving their numeric value and measurement unit but also a direction as well.

Quantities needed to identify their magnitudes as well as directions are called vectors.

Examples of these vectors are: force, acceleration, velocity and displacement.

Mention some other examples of vectors:

.... ، .... ، ....

Why are these vectors?

....

Information

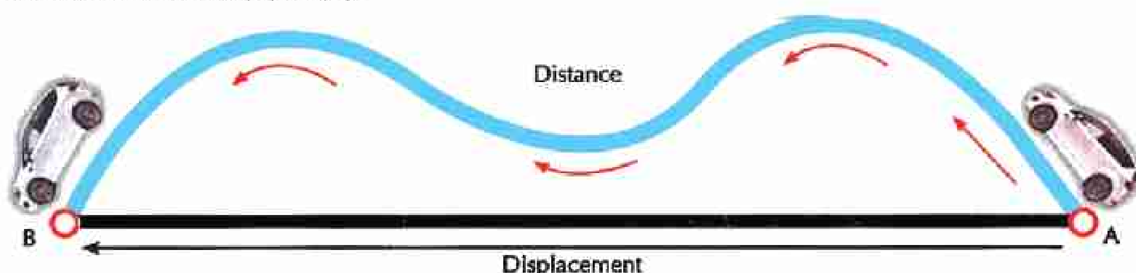
Enriching information

- All vectors are subject to mathematical operations called vectors algebra. Vectors have a great importance in different fields of physics and applied sciences like engineering. Understanding various physical phenomena such as gravity, movement of liquids and geometrical establishments depends basically on the main properties of vectors.

Distance and displacement

When a position of an object changes within a period of time, this means that the object has moved. This change in the position that accompanying the object does not depend on the path of the moving object but it depends on the shortest path between the start position and the end position where the object stops.

If an object moves from position (A) to position (B) as shown in figure (16), the change in its position is represented by the straight line that starts at point (A) and ends at (B) in the direction from (A) to (B).



▲ Figure (16): Difference between distance and displacement.



▲ Figure (17): The distance difference between Cairo, Benha and Tanta.

Exercise:

What is the difference between distance and displacement?

If a person wants to make a trip by car to Tanta starting from Cairo, the distance between Cairo and Tanta depends on the length of the path that the car takes as in figure (17).

Study the previous map and then answer the following questions:

1. If the trip's path is: Cairo – Benha, tanta how long is the covered distance?
   .... Kilometers.
2. If the trip's path is: Cairo – Zagazig - Tanta, how long is the covered distance?
   .... Kilometers.
3. We notice that there is a difference in the value of distance although the two cities Cairo and Tanta are constant.
4. If we assume that the trip between Cairo and Tanta is made directly, the direct distance between them is 93 kilometers in a direct line.

In this example:

Cairo represents the start of the trip while Tanta represents the end. Direct movement from Cairo to Tanta represents the change in the position of the moving object. The path (Cairo – Zagazig – Tanta) represents the **distance** of a possible movement. Also, the path (Cairo – Benha – Tanta) represents another distance of a possible movement.

Question for thinking

- When is the distance identical to the amount of displacement?

As for the straight (direct) distance whose start is Cairo and its end is Tanta represents the **displacement** of the car when reaches Tanta from Cairo. Displacement is characterized by both the magnitude and direction. The displacement of Tanta from Cairo = 93 kilometers in the western north direction.

What is meant by displacement?

Displacement is the length of the shortest straight line between two positions.

What is meant by a direction?

It is from the primary position of movement towards its final position.

Displacement is the covered distance at a certain direction and it is a vector, but distance is the actual length of the path that a moving object takes from the starting point of movement to the end point.

Information

Enriching information

- Two equal displacements have the same magnitude and the same direction

Velocity

There is a difference between the speed and the velocity. The velocity it is the speed in a given direction To determine the velocity we must know the value of the speed and its direction. The predator animal (cheetah) is one of the fastest animals, where its speed reaches 27 m/second. If we want to represent its velocity, we should define the direction of its movement. We say for example that cheetah's velocity = 27meters/second in the west direction.



▲ Figure (18): The cheetah is the fastest animal.

How can we calculate the Velocity?

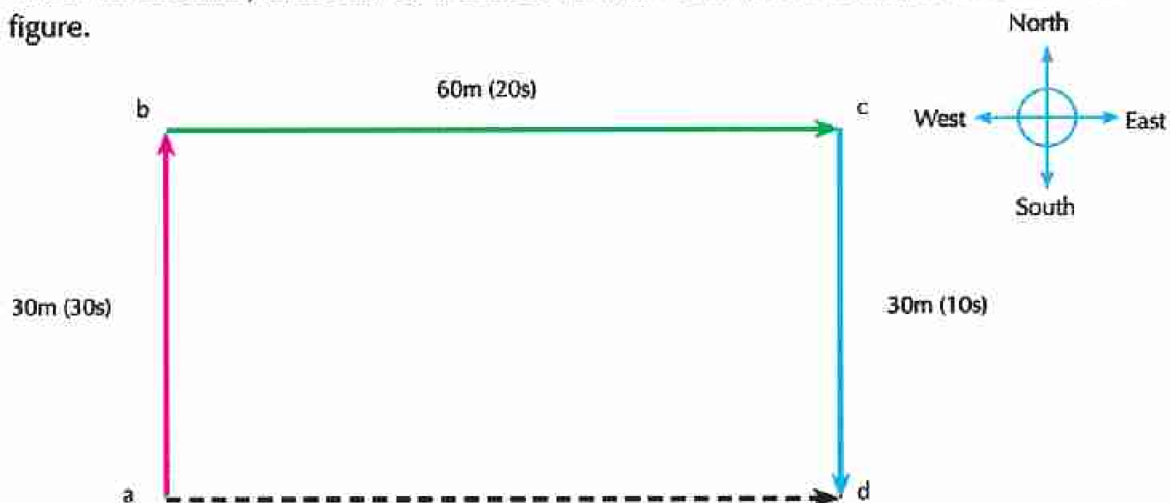
Based on previous observations, the velocity is a vector quantity. To determine it accurately, it is necessary to identify its magnitude and direction. Calculating the average velocity can be done through the following relationship:

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Total time}}$$

This means that the velocity is the displacement in one second. It is a vector that has the same speed units (meter / second or kilometer / hour).

Solved Example:

A person covered 30 meters northward within 30 seconds, then 60 meters eastward within 20 seconds, and then 30 meters southward within 10 seconds as shown in the figure.



Assume that the path the person took is a ⟶ b ⟶ c ⟶ d

1. What is the start point of movement? (a)
2. What is the end point of movement?. (d)
3. What is the value of total distance that the person covered?. 30+60+30=120m
4. What is the value of total time that the person took to cover this distance?. 30+60+10=60 sec
5. What does the direction line between point (a) and (d) in the direction from (a) to (d) represent? straights

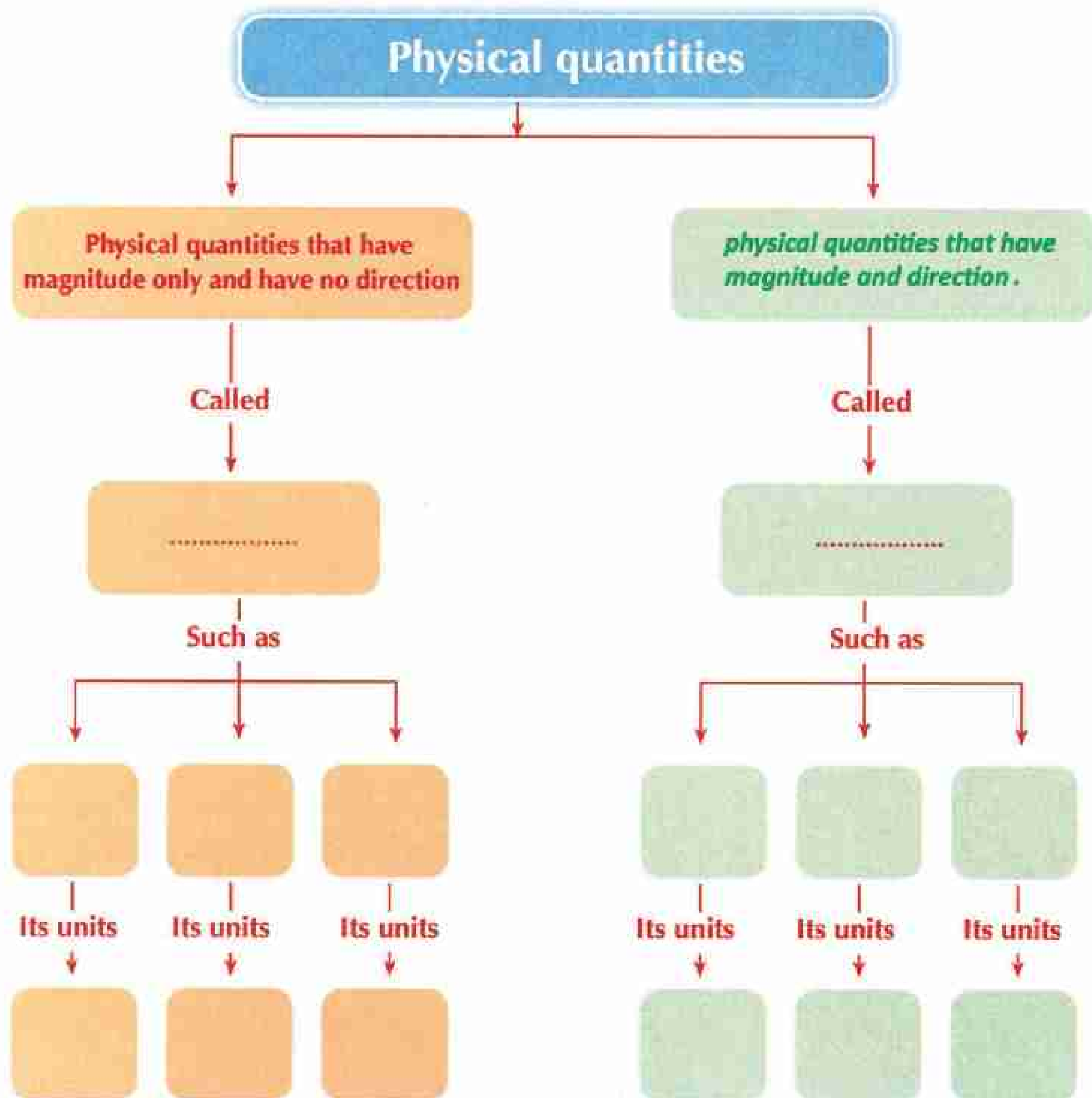
∴ Displacement = 60 meter in the east direction.

Calculate the velocity:

The average velocity = $\frac{60}{60}$ = 1 meters/second in the direction of east

Exercise: scalars and vectors

Complete the flow of concepts:



Lesson 3 exercises

1 Define each of the following:

(a) A vector quantity. (b) Scalar quantity. (c) Displacement.

2 If you move a distance of 5 meters northward and your colleague moves a distance of 5 meters southward, compare between:

(a) The distance that you covered and the distance that your colleague covered.

(b) The displacement that you covered and the displacement that your colleague covered.

3 Choose the right answer:

(a) .... is the physical quantity that both its magnitude and direction are necessary for identifying it.
1- the quantity of matter 2- Scalar quantity 3- Vector quantity

(b) Measurement units of velocity:
1- meter/second 2- meter 3- meter/second^2

4 Complete the following statements:

(a) .... is the covered distance in a constant direction and is a vector quantity.

(b) .... is the value of displacement at a unit time and is a vector quantity.

(c) .... is the quantity that is charactierized by the magnitude only.

(d) .... is the quantity that its magnitude and direction are necessary for identifying it .

5 A racer covered 50 meters northward within 30 seconds then 100 meters eastward within 60 seconds then 50 meters southward within 10 seconds, and then returns back to the start point within 40 seconds :

(a) How long is the total distance the racer moved?.

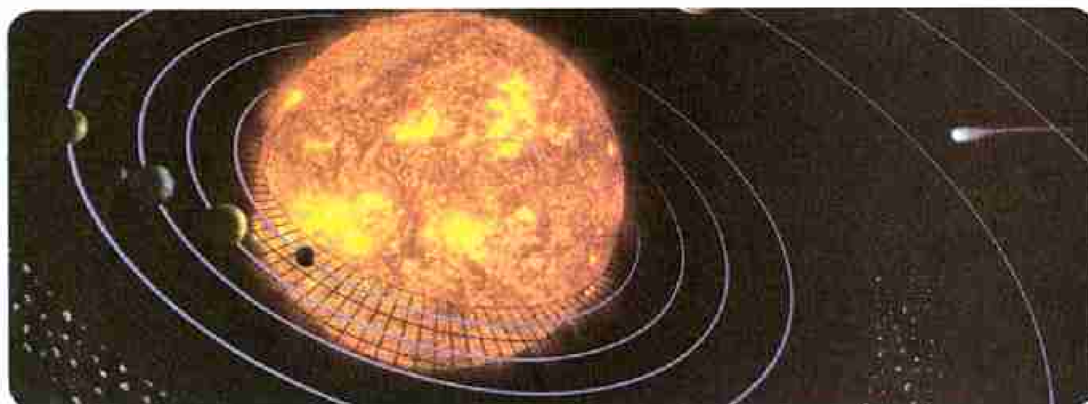
(b) What is the average speed of the racer?

(c) What is the displacement? What is the velocity?



Science, Technology and Society

Enriching activity



How can you calculate the time that light takes from the sun to the earth? To calculate this time, we take into consideration that light travels at constant regular speed in space.

The relationship of : $V = \frac{d}{t}$ can be applied to calculate time by knowing the speed of light and the distance between the earth and the sun as follows:

If the sun is 149000,000 kilometers away from the Earth and if the speed of light is 300,000 Km/s.

To calculate the time that light takes from the sun to reach the Earth the sun we assume that reach the sun sets at five o'clock in the evening. At what time did the sunlight travel in the direction of the Earth?

To calculate this time, we use the concept of speed noticing that the light speed is constant. This means that light travels at regular speed that can be determined through the following relationship:

$$\text{Speed of light} = \frac{\text{Total distance covered}}{\text{Total time}}$$

$$\text{Time} = \frac{\text{Total distance covered}}{\text{light speed}} = \frac{149000000 \text{ kilometer}}{300000 \text{ kilometer/second}} = 497 \text{ Second approximately} =$$

8 minutes and 17 seconds.

If the time of sunset is five o'clock it is determined that light travelled from the sun at four o'clock and fifty one minutes and thirty three seconds

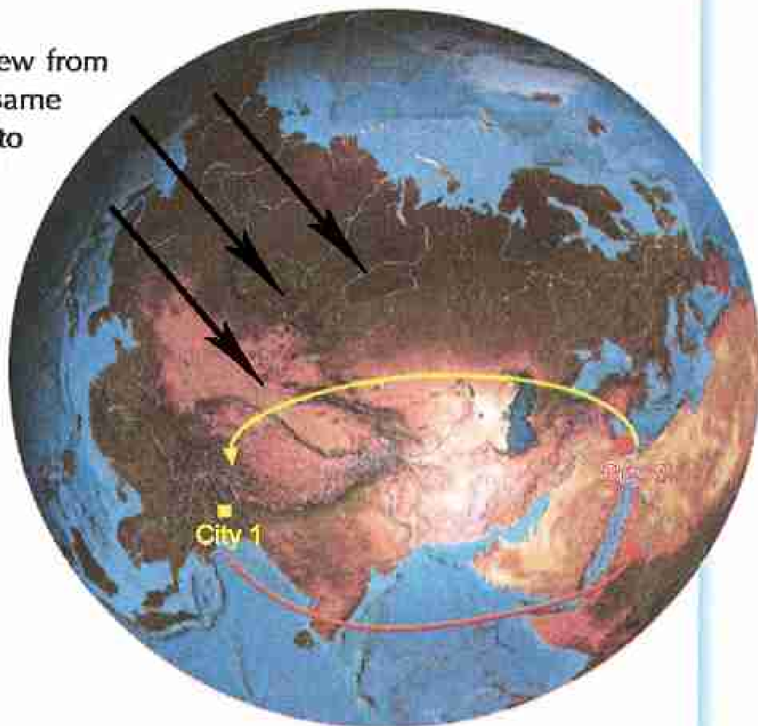
Technological application

On their flights, pilots take into consideration the velocity of the wind in order to calculate the amount of fuel necessary to complete the trip.

The Earth spins in a complete rotation every 24 hours. The movement of the Earth results in the movement of winds above its surface.

If we assume that a plane flew from city (1) to city (2) and at the same time a plane flew from city (2) to city (1),

The first plane flying from city (1) to city (2) takes a longer time than the second plane from city (2) to city (1). This is because the first plane flies in the opposite direction of the wind and consequently wind resistance is greater. So, it needs larger amount of fuel than the second plane although the covered distance is constant for each of the two planes.



Unit 1 Exercises

1 Choose the right answer:

a) Speed measurement unit is :
1) Meter. second. 2) Meter/second. 3)Meter/second^2

b) Acceleration measurement units is :
1)Meter/second. 2)Meter. second. 3)Meter/second^2

c) Displacement is a vector quantity and its unit is:
1)meter.
2)meter/second.
3)meter/secand^2.

d) The amount of the change in the velocity in one second equals:
1) Velocity. 2) Displacement. 3) Acceleration.

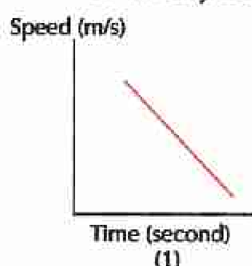
f) The object moves at constant uniform speed when:
1) It moves at zero acceleration.
2) It moves at constant acceleration.
3) It covers equal distances at unequal times.

g) It is said that the object moves at uniform acceleration when:
1) Its final speed is equal to its primary speed.
2) Its speed increases by equal amounts at equal times.
3) Covers equal distances at equal times.

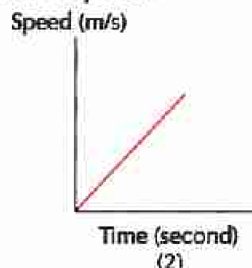
h) Acceleration is :
1) A vector whose units are m/s^2.
2) A vector whose units are m/s.
3) A scalar whose units are m/s^2.

i) The amount of change in speed at a time unit determines:
1) Velocity. 2) Displacement. 3) Acceleration

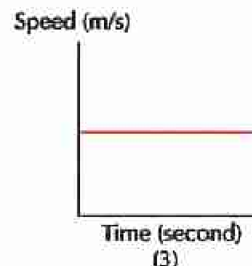
j) Which of the following graphs (speed – time) describes the movement of an object at a constant speed:



(1)



(2)



(3)

(k) A car moving on a straight line covers a total distance (d) in a total time (t), the average speed of the car is given by:

1) $\overline{V} = \frac{d}{t}$ 2) $\overline{V} = d\,t$ 3) $\overline{V} = \frac{t}{d}$

2 If an object at rest constancy moves regularly until its speed reaches 10 m/s after two seconds of the start of movement,so:

(a) The change in the object's speed after two seconds = ...m/s

(b) Acceleration = ...m/s^2

3 Problems:

(a) A special car can move from rest and its speed reaches 25 m/sec in 10 seconds. What is the acceleration with which the car moved?

(b) Within 2.5 seconds the speed of a car increases from 20 m/ sec to 25 m/sec, while a bike moves from rest and its speed reaches 5 m /sec in one second.

Which of them moved at a greater acceleration?

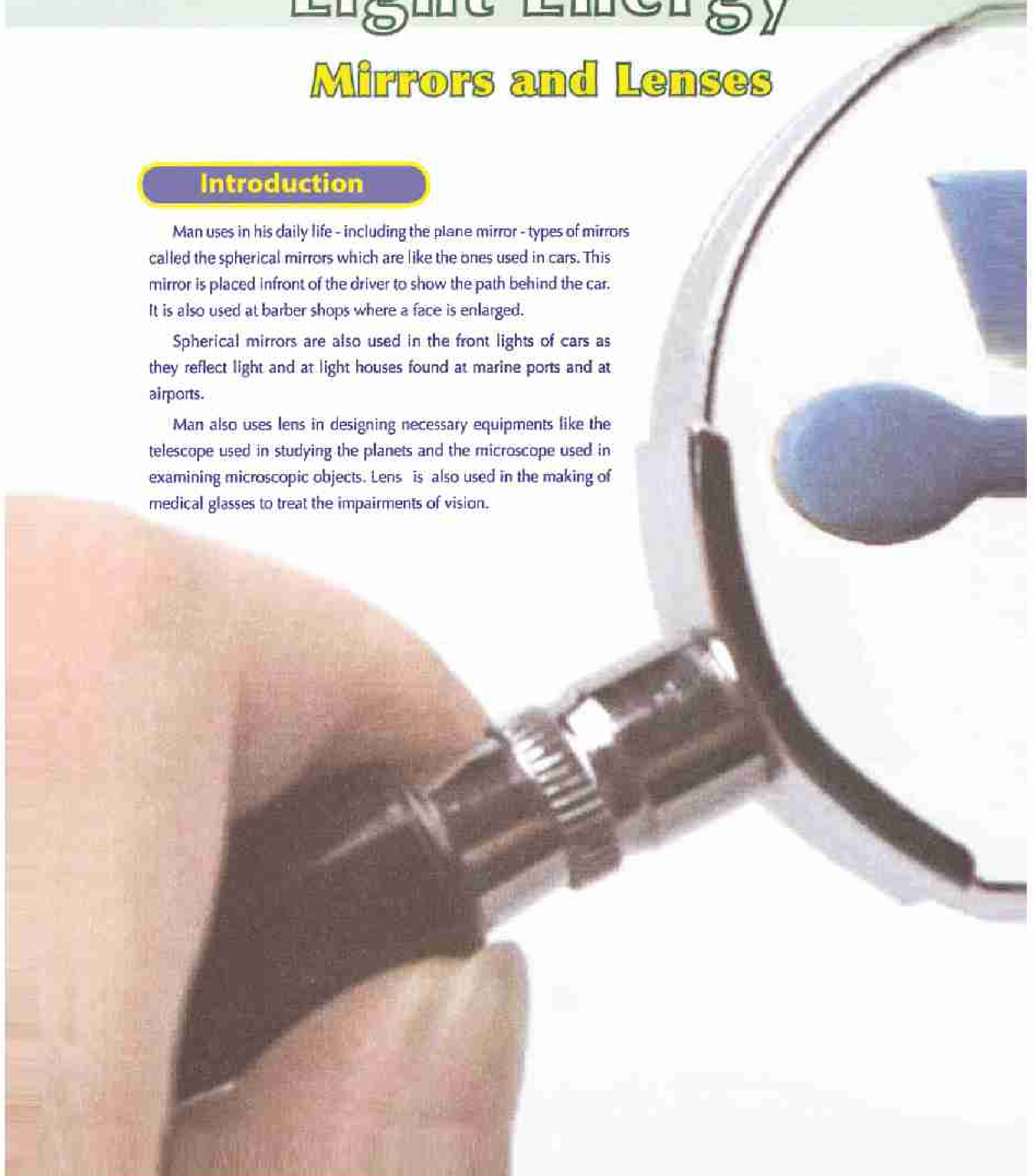
4 Complete the missing parts in the table:

Speed (meter/s)	Distance (meter)	Time (second)
....	100	5
5	....	10
8	96	....

The first term - Unit two

Light Energy

Mirrors and Lenses



Introduction

Man uses in his daily life - including the plane mirror - types of mirrors called the spherical mirrors which are like the ones used in cars. This mirror is placed infront of the driver to show the path behind the car. It is also used at barber shops where a face is enlarged.

Spherical mirrors are also used in the front lights of cars as they reflect light and at light houses found at marine ports and at airports.

Man also uses lens in designing necessary equipments like the telescope used in studying the planets and the microscope used in examining microscopic objects. Lens is also used in the making of medical glasses to treat the impairments of vision.

UNIT OBJECTIVES

By the end of this unit, students should be able to:

- ✔ Identify the special concepts of light reflection.
- ✔ Identify the properties of the image formed by the plane mirror.
- ✔ Identify some of the concepts of the spherical mirrors and lenses.
- ✔ Identify the properties of the image formed by the spherical mirrors.
- ✔ Compare between the convex and concave lenses.
- ✔ Conduct experiments to explain some of the cases of image formation by the mirrors and the lenses.
- ✔ appreciate the importance of the usage of lenses to treat some of the vision defects and the importance of mirrors in manufacturing the modern telescopes.

Included issues

- Safety and welfare
- Treating the vision defects



Lesson 1
Mirrors



Lesson 2
The lenses

Lesson 1

Mirrors



Lesson objectives

By the end of this lesson, you should be able to:

- Identify the reflection of light.
- Identify the two laws of light reflection.
- Identify the properties of the image formed by the plane mirror.
- Identify the two types of spherical mirrors.
- Identify some of the concepts of spherical mirrors.
- Identify how the images are formed in the spherical mirrors and their properties.
- Conduct experiments to show some cases of image formation on the spherical mirrors.



Lesson terms

- Cancave and convex mirrors
- The real and virtual image
- Principle and secodary axis

The human being noticed that when he looked at the still water surface, he could see an image of his face in the water, and he also noticed the images of the high buildings that are constructed near the still water. Moreover, if you look at the shinning smooth surface (like the mirror) you can see an image of your face. All this happens as a result of the reflection of light (its bouncing off) on the water surface or the mirror surface.



▲ Figure (1): The image of the buildings on water surface as a result of the light reflection.



The properties of the image formed by the plane mirror

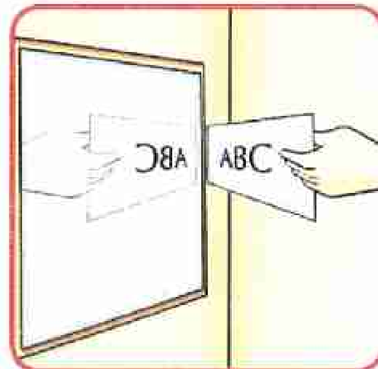
The material:

A plane mirror – a card with some letters written on it.

The steps:

Collaborate with your colleagues to accomplish this activity by preparing a white carton paper and writing some alphabet letters on it.

1. Place the card in front of the mirror that is fixed vertically.
2. Record your observation about the properties of the image formed in the plane mirror.



▲ Figure (2): The image reflects in the plane mirror.

Deduce the properties of the images formed by the plane mirror through answering the following questions:

- How does the image of the letters appear in the mirror? (Inverted / upright).
- How does the size of the letters appear in the mirror? (enlarged / smaller/ equal).
- Does the image of the letters in the mirror appear inverted? (Yes / No).
- Can you receive the letters formed in the mirrors on a screen? (Yes / No).
- Did you observe that the distance of every letter to the mirror is equal to the distance of its image to the mirror? (Yes / No).

From the previous activity, you will find that the properties of the image of the objects formed by the plane mirror are as follows:

1. The image is upright.
2. The image is equal to the object.
3. The image is laterally inverted. (reversed)
4. The image is a virtual image (cannot be received on a screen)
5. The distance of the object to the mirror = the distance of its image to the mirror. (The straight line connecting the object and its image is perpendicular on the surface of the mirror).



▲ Figure (3): The word «ambulance» is laterally inverted, (reversed) why?

Does the light reflection abide to laws?

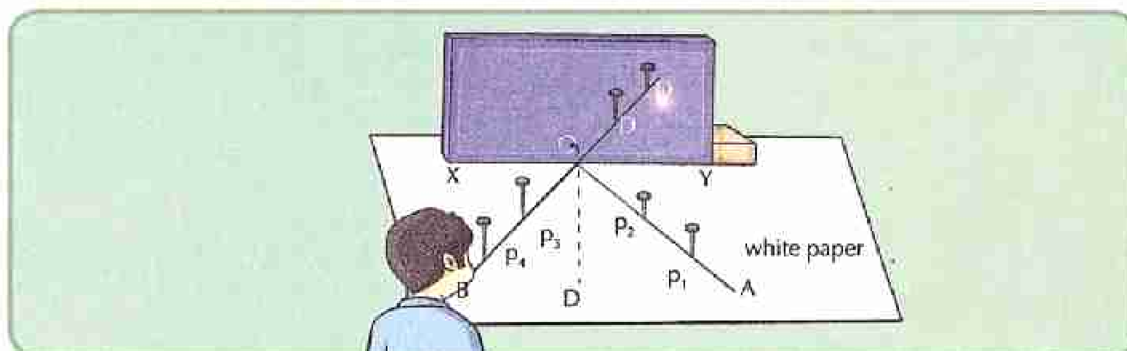
To answer this question, you will conduct the following activity:



The two laws of light reflection

Materials:

A plane mirror – white paper sheet – pins - protractor - ruler



▲ Figure (4): Achieving the two laws of reflection in mirrors

Steps:

1. Draw a straight line (xy) on the white piece of paper, then place the plane mirror in a perpendicular position where the edge of the reflective surface aligns on the line (XY).
2. Draw a line (OD) perpendicular on the line (xy). This line is called the normal.
3. Draw a straight line (AO), which represents the incident light ray on the mirror. makes an angle with the normal (angle of incidence) and place two pins (p_1) and (p_2) horizontal on the line.
4. Look at the other side of the mirror and see the images of the pins ($\bar{p_1}$) and ($\bar{p_2}$), and place two pins (p_3) and (p_4) to be as straight as the images of ($\bar{p_1}$) and ($\bar{p_2}$).
5. Lift the two pins (p_3) and (p_4) and connect between their positions with a straight line extending it until it meets the reflecting surface at point (O). This line (BO) represents the reflecting ray.
6. Measure the angle that (BO) makes with the normal, and this is the angle of reflection
7. Repeat these steps by changing the value of incidence angle by using the protractor and assign the reflection angle each time.

Does the angle of incidence = the angle of reflection? (Yes / No)
The Results

Laws of the reflection of light:

1. **First law: angle of incidence = angle of reflection.**
2. **Second law: The incident light ray, the reflected light ray and the normal line all lie in the same plane perpendicular to the reflecting surface.**

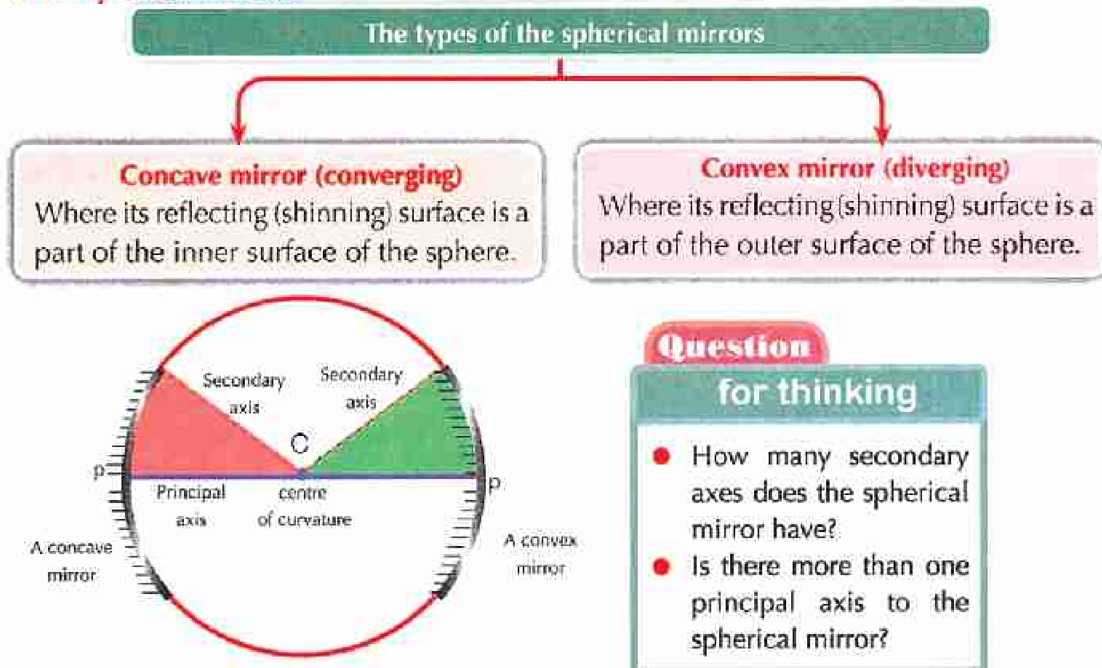
Concepts concerning reflection of light:

- Light reflection phenomenon : is the bouncing the incident light ray in the same medium when it strikes a reflecting surface.
- The incident ray: it is the light ray that falls on the reflecting surface.
- The reflected ray: it is the light ray that bounces from the reflecting surface.
- Angle of incidence: it is the angle between the incident ray and the prependicular line on the reflecting surface from the point of incidence.
- Angle of reflection: it is the angle between the reflected light ray and the prependicular line on the reflecting surface from the point of incidence.

The spherical mirrors

What is the spherical mirror?

It is a mirror that its reflecting surface is a part of a hollow sphere, and there are two types of the spherical mirrors.



▲ Figure (5): Types of the spherical mirrors

Observe figure (5) and identify the concave mirror and the convex mirror.
Study the previous figure and identify the concepts that benefits you when are studying how the image is formed by the spherical mirrors:

- Centre of mirror curvature (C): Is the centre of the sphere that the mirror is considered a part of it.
- Define the position of the centre of curvature of the concave mirror? (in front of the reflecting surface / behind the reflecting surface).
- Define the position of the centre of curvature of the convex mirror? (in front of the reflecting surface / behind the reflecting surface).
- The radius of curvature of the mirror $(\bar{r})$: Is the radius of the sphere that the mirror is a part of it.

- The pole of the mirror (p): Is the point that is in the middle of the reflecting surface of the mirror.
- The principal axis $\overleftrightarrow{cp}$: Is the straight line that passes by the pole of the mirror and its centre of curvature.
- The secondary axis : Any straight line that passes by the centre of curvature of the mirror and any point on its surface except the pole of the mirror.

The focus of the concave mirror:

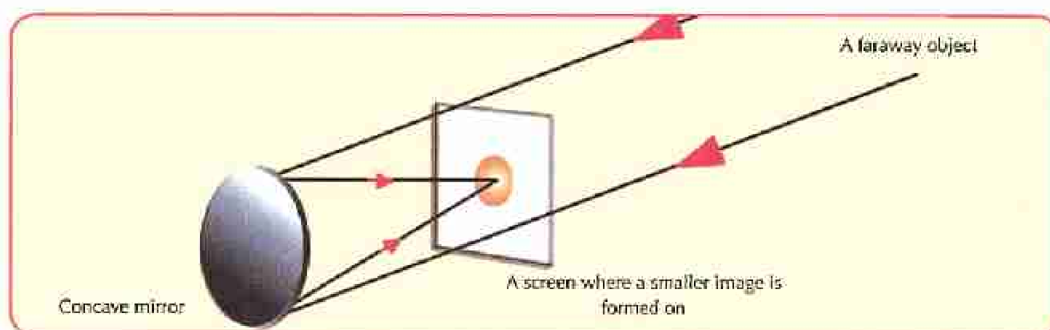
When sun rays or light rays from a distant object falls on the surface of a concave mirror, they are reflected from it and collected at one point called "the focus of the mirror".



Determine the focal length of the concave mirror.

The materials:

A concave mirror - screen - graduated tape (meter).



▲ Figure (6): If the object is very far, the light rays that fall on the concave mirror is almost parallel.

The steps:

1. Place a concave mirror facing the sun ray (or a faraway object)
2. Move the screen in front of the reflecting surface of the mirror to obtain the smallest and clearest image (lit point), it is "the focus of the mirror" (fig.6).
3. Measure the distance between the lit point and the pole of the mirror, this distance is the focal length (f) of the concave mirror.

Conclusion:

- Did the rays after being reflected from the concave mirror collect in one point that can be received on a screen (Yes / No).
- The point of the collection of the parallel rays after being reflected from the concave mirror is called ....
- The distance between the focus of the concave mirror and its pole is called..........................

We will see that: focal length = 1/2 × radius of curvature

$$(f) = \frac{1}{2} R$$

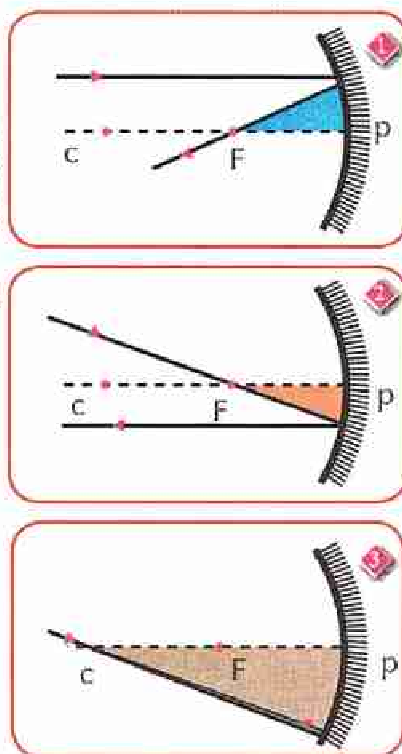
The image formed by the concave mirror:

To study the cases of the formation of the images by the spherical mirrors, we will use three rules to determine the direction of the reflecting light rays incident on the concave mirror:

1. The incident light ray parallel to the principal axis of the mirror. reflects passing through the focus (F)
2. The incident light ray passing the through focus(F) will reflect parallel to the principal axis.
3. The incident light ray passing through the centre of curvature of the mirror reflects back on itself.

When you place an object in front of a concave mirror you can determine the position of the image of the object and its properties by using only two rays from the previous three rays.

- The real image is the image that can be formed on a screen.
- The virtual image is the image that cannot be formed on a screen.



▲ Figure (7): The reflection of the incident rays on the concave mirror.

Exercise:

The cases where the images are formed by concave mirror (converge).

To determine the position and properties of the images formed by the concave mirror, follow the following steps:

1. Use the compass to draw a spherical surface and its centre is (c), that represents the concave mirror.
2. Draw the principal axis and determine on it the position of the focus then draw a vertical arrow on the principal axis to represent an object. Determine the centre of curvature where the radius of the sphere equals twice the focal length.
3. Draw a ray from the highest point in the object where it falls parallel to the principal axis and thus reflects passing through the focus.
4. Draw another ray passing through the centre of the mirror curvature then reflects on itself (why does the ray reflect on itself)?.
5. Determine the position where the two reflecting rays meet, which is the image of the highest point of the object.
6. Determine the position and properties of the images formed in the cases shown in the following table, and compare the results you obtain with that indicated in the table.

Position of the object	Position of the images	Properties of the images	The cases of image formation
At a distance greater than the radius of curvature.	Between the focus and the centre of curvature	Real – inverted -diminished	
At the centre of curvature of the mirror.	At the centre of curvature of the mirror.	Real – inverted. - equals the object	
Between the focus and the center of curvature	At a distance greater than the radius of curvature.	Real - inverted magnified	
At The Focus	At The infinity (light spot) (no image)	The rays exit paralled	
At a distance loss than the focal length	Behind the mirror	Virtual-upright magnified	

The formation of the images on a convex mirror:

The image of the object placed in front of a convex mirror is always smaller than the object, upright and virtual (not received on a screen) even if the distance of the object is changed form the convex mirror.





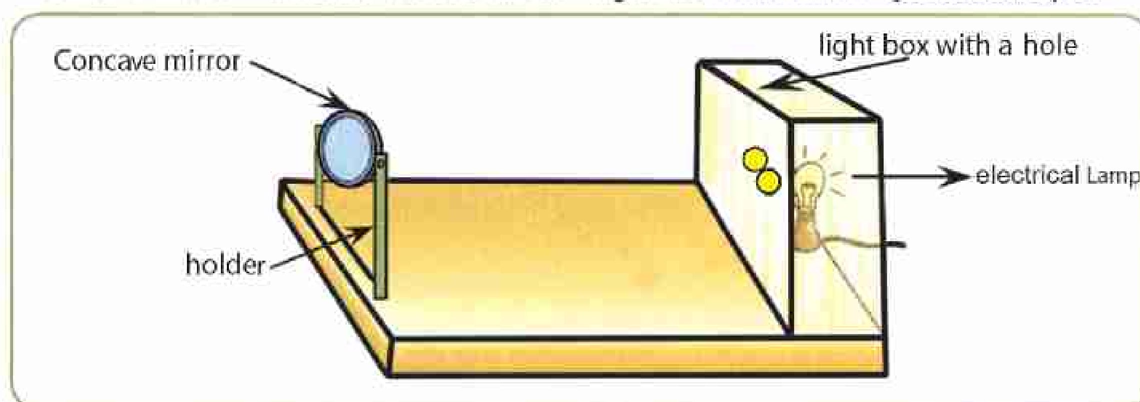
▲ Figure (8): The image that is formed by the convex mirror is virtual, upright and smaller than the object.



Determine half the radius of the concave mirror.

The materials:

A concave mirror – a holder for the mirror – light box with a hole–graduated tape .



▲ Figure (9): To determin the radius of curvature of the concave mirror

The steps:

1. Place the mirror on a holder in front of the light source (lit hole).
2. Move the mirror nearer and farther until an image of the hole is formed next to it and is equal to it.
3. Measure the distance between the mirror and the hole, it is equal to the radius of curvature of the mirror.

Deduce: The focal length of the mirror (f) = R/2

Uses of spherical mirrors

(A) The concave mirror is used.......

1- To reflect the emitted light from the front bulbs in cars.

2- In producing the telescopes that monitor the space.

3-by The dentist uses it during his work.

4- In magnifying the human face during skine care.

5- In solar oven.

(B) The convex mirror is........

1- placed to the right and left of the cars' driver.

2- used at shopping centers that need to high rates of secuirity.

3- used at the corners of the narrow roads to monitor the car movement to avoid accidents.

4- used at cars' parking.

5- placed on the plateforms of metro(subway) and railway stations to avoid passenger harmful at opening or closing the doors.

Lesson 1 exercises

2 Complete the following:

a) The phenomenon of the light bouncing off in the same meduim when it meets the reflecting surface is called ....

b) The point that is in the middle of the reflecting surface of the concave mirror is called ....

c) The radius of the concave mirror equals.................................. of its focal length.

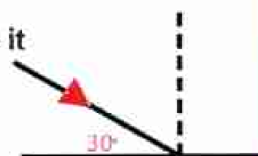
d) .... is the image that can be received on a screen.

e) The incident light ray parallel to the principal axis of the concave mirror, it will reflects and passing through ....

2 Choose the correct answer:

a) If the light ray falls passing through the focus of the concave mirror it will:
1- Reflect parallel to the principal axis.
2- Reflect on itself.
3- Reflect through the centre of curvature.

b) A light ray that falls on a plane mirror as in the figure it reflected where the reflection angle equals:
1- 30° 2- 60° 3- 90°



c) A concave mirror with a focal length of 20 cm and the object is placed at a distance of 50 cm from the mirror, the image is formed at a distance:
1- More than 40 cm
2- More than 20 cm and less than 40 cm
3- Equals 20 cm.

d) A spherical mirror where its radius is 60 cm and, its focal length is equal to:
1- 60 cm 2- 120 cm 3- 30 cm

e) When the object is at the centre of concave mirror curvature the image is:
1- Real, inverted, and diminished.
2- Real, inverted, and equals to the object.
3- Virtual, inverted, and enlarged.

Lesson 2

Lenses



Lesson objectives

By the end of this lesson, students should be able to:

- Identify the types of lenses.
- Identify the concepts related to the lenses.
- Identify how the images are formed with the lenses.
- Do experiments showing some of cases of the formation of the image with the lenses.
- Identify how to use the lenses in treating some of the vision defects.



Lesson terms

- The convex lens
- The concave lens
- The focus of the lens
- Short-sighted
- Long-sighted

You have noticed that many people need the medical eye glasses either for reading or walking. You could see the person who fixes the watches use a magnifiging gloss to see the minute parts of the watch. In the war, the leaders use a magnifying glass to follow the battles.

In all these previous cases the human being uses an important optical piece called "the lens".





▲ Figure (10): The lenses are used in the manufacture of many things.

What is a lens?

The lens is a transparent medium that refracts the light and is defined with two spherical surfaces and is usually made of glass or plastic.

The types of lenses:

There are a lot of types of lenses we, some of them are:



▲ Figure (11): The convex lens

1 Convex lens (converging):

- It is thick at the centre and less thick at the tips. The function of the convex lens is to collect the light rays falling on it..

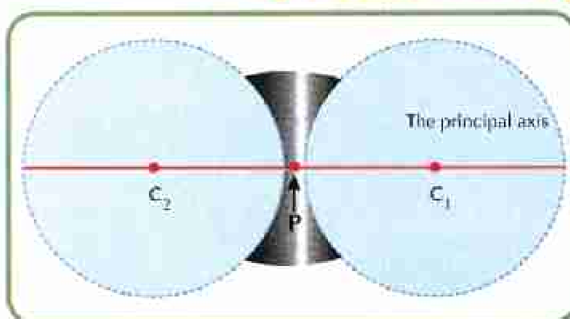
2 Concave lens (diverging)

- It is thin at its centre and more thick at the tips. The concave lens diverges the light rays falling on it.

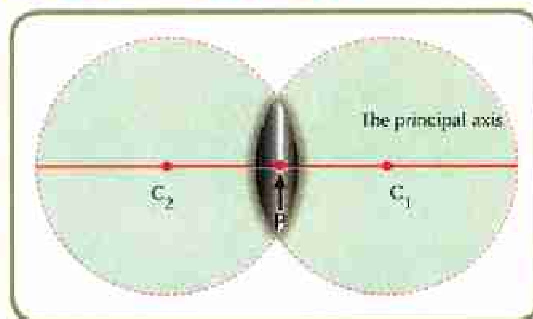


▲ Figure(12): the concave lens

Special concepts of the lenses



▲ Figure (13): A concave lens (diverging)



▲ Figure (14): A convex lens (converging)

Study the previous figure and identify the following concepts:

1. The centre of curvature of the lens face (c): Is the centre of the sphere where this face is a part of it.

Why does the lens have two centres of curvature?

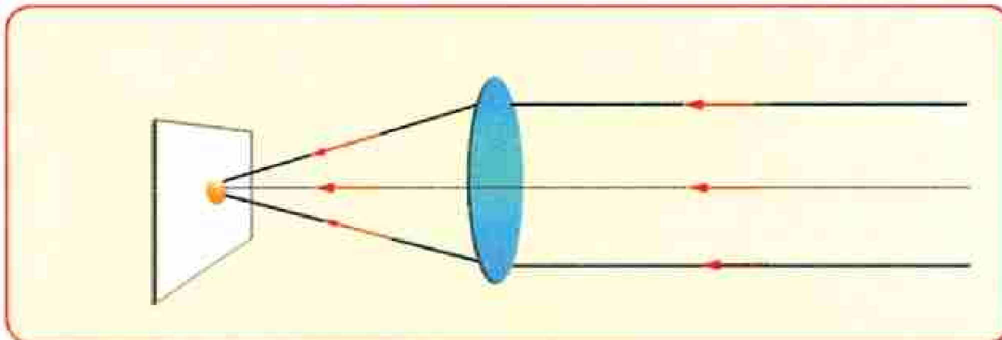
....

2. The optical centre of the lens (p): Is a point inside the lens lies on the principal axis in the mid distance between its faces.
3. The radius of curvature of the face of the lens (p): Is half the radius of the sphere where the face is a part of it.
4. The principal axis: Is the line between the centres of curvature of the lens passing by the optical centre of the lens.

First: The convex lens

The focus of the convex lens (converging):

If the sun rays or any light rays from any distant source fall on the lens we notice that the rays passing through the lens are collected at one point called "the focus of the lens".



▲ Figure (15): The convex lens forms a real, inverted, smaller image of the distance object.



Determination of the focal length of the convex lens

Materials:

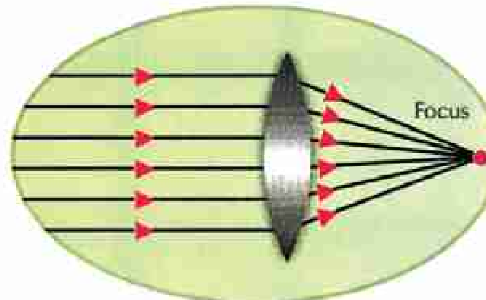
A convex lens – screen – lens holder – distant source of light (can use the sun ray)

The steps:

1. Place the lens on a holder where the distant light source is facing one of its faces.
2. place a vertical screen on the other side of the lens and move it closer and farther from the lens until you get the light point which is the «focus of the lens».
3. Measure the distance between this point and the optical centre of the lens which is the focal length (f) of the convex lens.



▲ Figure (16): The convex lens collects the sun rays its focus on a paper, so the paper is heated till it is burning.



▲ Figure (17): Parallel rays are collected at the focus on the far side of a convex lens

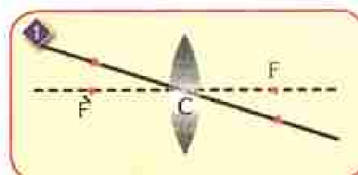
What do you deduce?

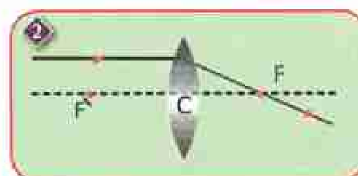
- Light rays passing through the convex lens converge to a point called "the focus of the lens".
- The lens in this case is known as converging because the rays passing through it converges at a point.

The image formed by the convex lens:

To study the cases of the formation of the image by using the convex lens we will use three rules to determine the direction of the light ray after passing through the lens.

1. The incident light ray passing through the optical centre of the lens passes through the lens without refraction.
2. The incident light ray parallel to the principal axis, exits from the lens passing through the focus
3. The incident light ray passing through the focus, exits from the lens parallel to the principal axis.





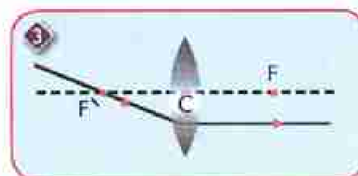


Figure (18): path of the incident rays on convex lens

When an object is placed in front of the convex lens the position of the images formed and their properties can be determined by using only two rays from the previous three rays.

The cases of the formation of the images by the convex lens (converging):

To determine the position and characteristics of the formed image by the convex lens, follow the following steps:

1. Use the compass to draw the convex lens
2. Draw the principal axis of the lens (it is a straight line passing by the focus and the optical centre of the lens).
3. Determine on it the position of the focus (f) and twice the focal length (c) on the principal axis from both sides of the lens.

4 Draw a ray coming from the highest point of the object so it falls parallel to the principal axis thus it refracts and exits from the lens passing through the focus.

5 Draw a ray from the same point passing by the optical centre of the lens, thus exits with no refraction.

6 The position when the two penetrating rays intersect determines the image of the light point.

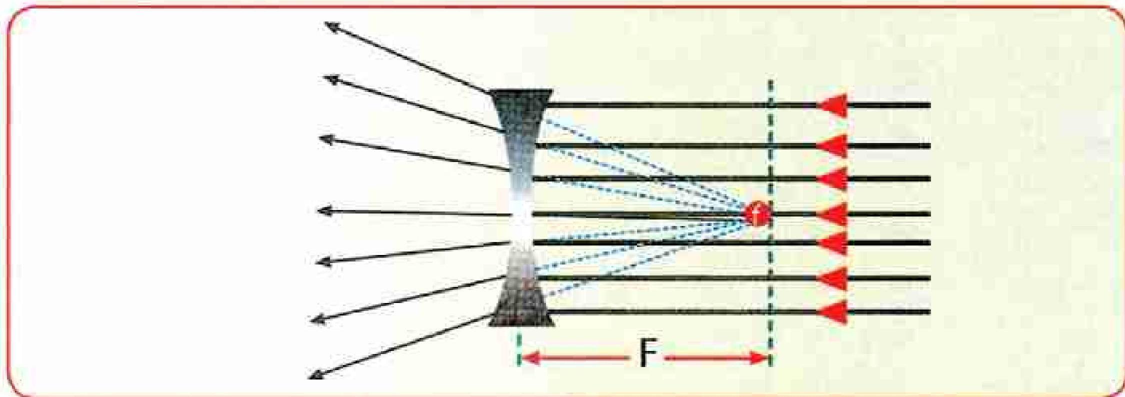
7 Determine the position and properties of the images formed in the five cases shown in the following table and compare the results you obtain to those present in the table.

Position of the body	Position of the image	properties of the image	Cases of image formation
Greater than twice of the focal length	Between the focus and twice the focal length	Real, inverted, and diminished	The object, C, F, F, C, The Image
At twice the focal length	At twice of the focal length	Real, inverted and equal to the object	The object, C, F, C, The image
Between the focus and twice of the focal length	At a distance greater than twice of the focal length	Real, inverted and magnified	The object, C, F, F, C, The image
At the focus	At the infinity (as light spot form)	The rays exit parallel	The object, F, F
At a distance smaller than the focal length	At the side of the object	Virtual, upright and enlarged	The image, F, F

Second: The concave lens

The focus of the concave lens:

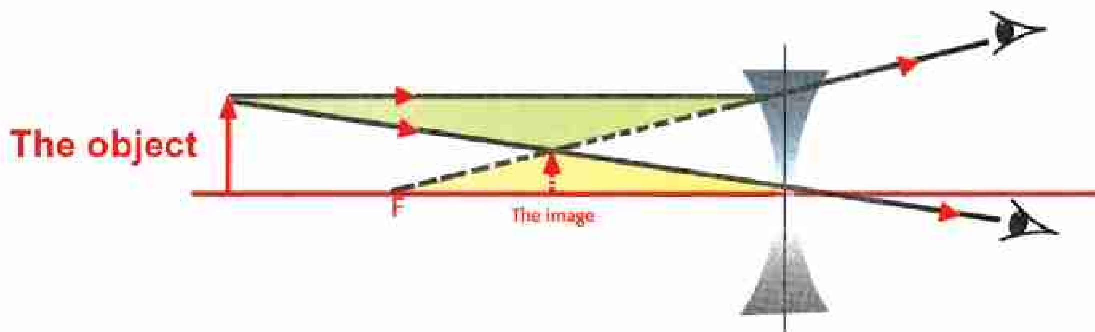
If parallel rays fall on the concave lens, the rays pass through the concave lens and get awayfrom each other (diverging) as if they come from a point in front of the lens called "The principle focus of the concave lens" and it is a virtual point (cannot be received on a screen). The lens is also known in this case as the diverging lens because it diverges the rays after they pass through it.



▲ Figure (19): The virtual focus of the concave lens

The image formed by the concave lens:

The image formed by the concave lens is always virtual, smaller than the object and upright In figure (20) we used two rays to identify how the image of the object is formed.



▲ Figure (20): The image formed by the concave lens is always virtual, upright and diminished

The use of lenses to treat the vision defects

The most important of the vision defects: short-sightedness – long-sightedness.

These defects occur because the lens of the eye is not always convex, or the eye is not always spherical. The person with normal vision sees the far object clearly (the far object according the normal eye is present at 6 m). This clear vision remains if the object comes closer at a distance not less than 25 cm.

❶ Short-sighted:

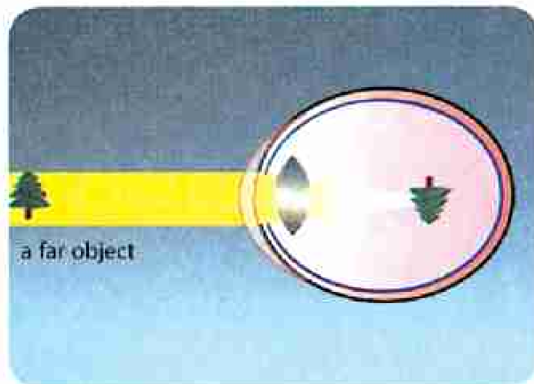
- A person is said to be short-sighted when the eyes only sees the near objects clearly, but the far objects seem distorted and that is because the images of these objects do not fall on the retina of the eye but in front of it.

What causes short-sightedness?

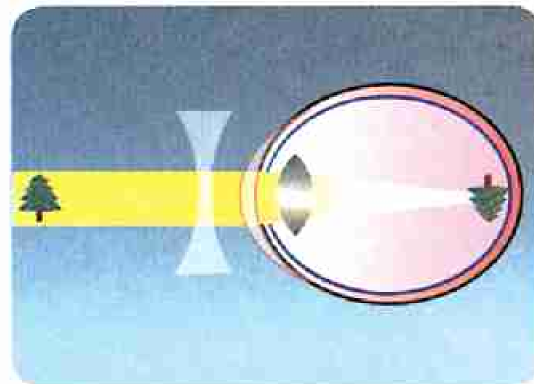
1. Due to elongation in the ball which causes the retina to be far from the eye lens.
2. The surface of the eye lens is more convex which results in a smaller focal length of the eye lens, then the parallel rays coming from the far object is collected at a point in front of the retina and disperses after that forming an unclear image on the retina (Figure 21).

Correcting short-sightedness

By using a concave lens which diverges the rays to form the image of the objects on the retina. A short-sighted person needs a medical eye glasses with concave lenses.



▲ Figure (21) Formation of image in front of retina



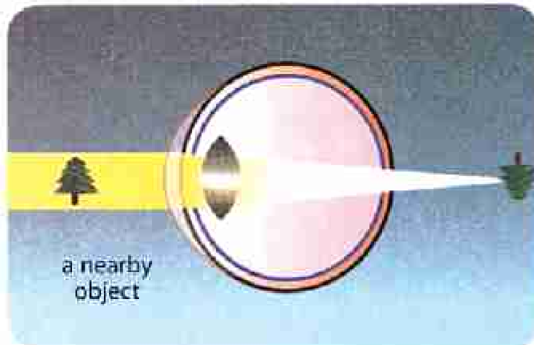
▲ Figure (22) Formation of image on the retina by using a concave lens

❷ Long-sighted:

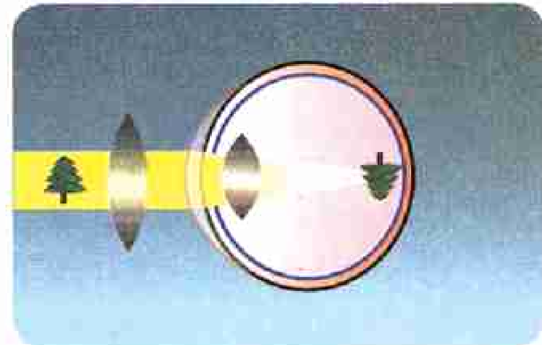
A person is said to be long-sighted when he only sees the far objects clearly but the close objects are not seen clearly and that is because the image of the close objects do not fall on the eye retina but behind it.

What causes long-sightedness?

1. As a result in the shortness of the radius of the ball thus the retina is close to the eye lens.
2. The eye lens surface is less convex which causes the increase in the focal length so the rays exiting from the near object are collected at a point behind the eye retina.



▲ Figure (23): Formation of image behind the retina



▲ Figure (24): Formation of image on the retina by using a convex lens

Correcting long-sightedness

Long-sightedness is treated by using convex lens which collects the rays so the images of the objects are formed on the retina; therefore, the long-sighted person needs a medical eye glasses with convex lenses.

Contact lenses:

The contact lenses are used instead of the glasses. It is very thin lenses made of plastic, and can stick to the eye cornea by the eye fluid.



▲ Figure (25): contact lenses

Lesson 2 exercises

1 Complete the following:

(a) The focal length of the convex lens equals the distance between .... and ....

(b) The concave lens .... the rays fall on it.

(c) A convex lens the distance between its focus and optical centre is 10 cm, so the double its focal length is..........................cm.

(d) The short-sighted person needs a medical eye glasses with .... lenses

(e) The vision defect which is due to a shortness in the radius of the ball is called..........................

2 Choose the correct answer:

(a) If a light ray falls passing the optical centre of the convex lens, it leaves the lens :
1_Passing through the focus.
2_ Parallel to the principal axis.
3_ Without refraction.

(b) A convex lens with a focal length of 20 cm, and an object was placed 40 cm from the lens the image of the object is formed at:
1- 40 cm 2- 20 cm 3- 10 cm

(c) An object placed at a distance less than the focal length of the convex lens, the propeties of the image formed are :
1_ Real, inverted, and enlarged.
2_ Real, inverted and smaller
3_ Virtual, upright, and enlarged.

3 Show by drawing only the formation of the image equal to the object by means of a convex lens.

4 Mention the position and properties of the image formed of an object by means of a convex lens in each of the following cases:

(a) The object is at a distance larger than the focal length and smaller than twice the focal length.

(b) The object is at a distance equal to twice the focal length.



Science, Technology, and Society

Enriching activity:

Land areas measurement:

Land surveyors and topographical scientists use a special device to determine heights and distances by sending a beam of laser rays, the receiving it again by the mirrors and lenses provided in their devices.
so, it is possible to make very accurate measurements to calculate the time that a laser beam bounced from a distant point and returns to its source.



Make a model

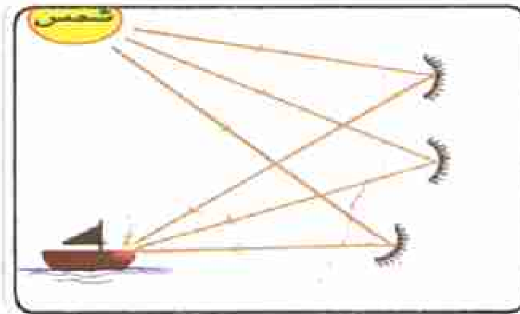
Draw a schematic diagrams showing how the proprerties of the image formed by a convex lense changed by changing the focal length.



History

According to the old Greek legend that Archimedes knew a lot about mirrors and the use of sunlight as a weapon against the Roman fleet that invaded sicily in 212 B.C.

A huge concave mirror was placed to collect the sun rays and directed them towards the sails of ships so as to generate extreme heat that led to the burning of these sails and turning them to glazing fire balls.



Science integration (Medicine)

Cataract

The eye gets suffer from some diseases. due to some reasons.

Cataract is one of the most dangerous diseases that infect the eye as a result of old age, illness, side effects of drugs in addition to genetic readiness. When the eye gets injured by cataract the eye lens becomes opaque. Treatment is done through surgery to exchange the eye lens with a plastic lens transplanted permenantly in the eye. In this way, the person can see again and clearly .



Unit 2 Exercises

1 Choose the correct answer from the given choices:

a) If a light ray falls parallel to the principal axis of a concave mirror it reflects:
(1) Passing by the spherical centre of curvature of the mirror.
(2) Passing by the focus.
(3) On itself.

b) An object is placed at the focus of a convex lens, the position of the formed image will be:
(1) Between the focus and centre of curvature.
(2) At the centre of curvature.
(3) The image is not formed.

c) A concave mirror has a focal vertex of 10 cm, so the radius of curvature of its surface equals:
1 - 5 cm   2 - 10 cm   3 - 20 cm

d) A convex lens has a focal length of 50 cm. An object is places at a distance of 80 cm from the lens. The image of the object is formed at a distance of
(1) Greater than 100 cm
(2) Equals 100 cm
(3) Equals 50 cm

e) The image formed by using a concave lens is :
(1) Real, enlarged, and inverted.
(2) Virtual, smaller and inverted.
(3) Virtual, smaller and upright.

2 Complete the following:

a) The point that is in the middle of the reflective surface of the concave mirror is called ....

b) The straight line that passes by the pole of the mirror and its centre of curvature is ....

c) The distance between the focus of the concave mirror and its pole is called ....

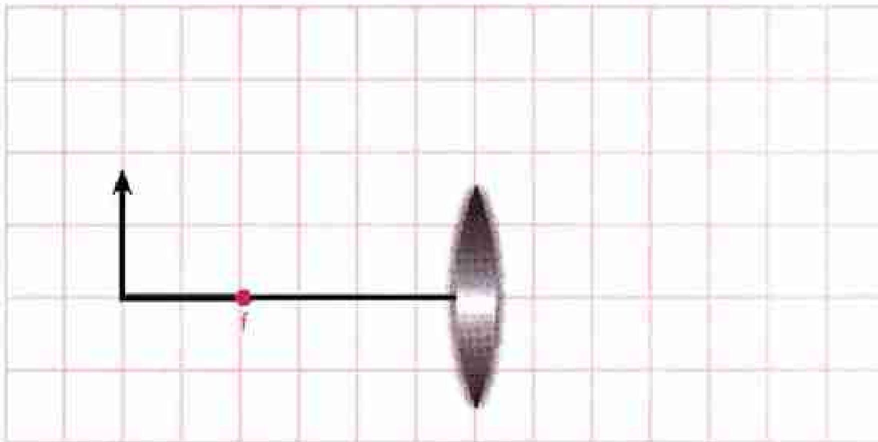
d) A convex mirror has a focal length of 20 cm, then the radius of carvature of its spherical surface equals ....

e) A long-sighted person needs a medical eye glasses with a .... lens

3 **Explain the following:**

a) The focal length of the thick convex lens is less than that of the thin convex lens.
b) The concave lens is used to treat a short-sighted person.
c) The long-sightedness is treated by using a convex lens.
d) The object that is placed at the focus of a convex lens does not form an image.
e) The collective lens has two foci while the collective mirror has one focus.

4



A convex lens has its focal length equals 4 cm. An object is placed at a distance of 6 cm from the lens. Determine the position of the formed image and its properties by drawing two light rays only.

The first term - Unit Three

The Universe and the Solar System

Introduction

The vast universe is filled with millions of stars that are not enough to light this extensive universe. This is because there are billion kilometers of cold dark space among these stars.

Everything changes in the universe. On Earth, generations of humans and living organisms change. The same goes for stars as they always change so that the universe is never constant.

All galaxies get away from each other very fast. The universe is continuously in a state of expansion.



UNIT OBJECTIVES

By the end of this unit, you should be able to:

- ✔ Identify some theories of cosmogony.
- ✔ Identify some theories of the evolution of the solar system.
- ✔ Identify the rotation of the solar system around the centre of the galaxy.
- ✔ Explain the difference in the length of day and year from a planet to another.



Included issues

- The greeatness of Allah
- Unity of the universe



Lesson 1

The universe and solar system

Lesson 1

The Universe and Solar System



Lesson objectives

By the end of this lesson, you should be able to:

- Identify the components of the universe.
- Identify the galaxies.
- Determine the location of the solar system in the Milky Way.
- Identify the latest theories of cosmogony.
- Realize the greatness of Allah.



Lesson terms

- The universe
- The galaxy
- The stars

What is the universe?

The universe is the space which contains all the galaxies, stars, planets, moons, living organisms and everything. The universe is vast beyond comprehension. The sun and the earth are a tiny part in the universe.

In the universe, groups of stars are gathered to form galaxies. The universe contains many galaxies and each galaxy has a distinctive shape according to the harmony and order of the groups of stars in it. The sun is one of the stars of our galaxy (Milky Way).

The Milky Way Galaxy

In the centre of the galaxy a lot of old stars gather surrounded by small stars located in the spiral arms of the galaxy. Our sun is a star of millions of stars in this galaxy.



Figure (1) The Milky Way Galaxy

The universe :

- It is a wide and extended space that contains galaxies. The number of galaxies in the universe is about 100,000 million galaxies.



Galaxies:

- Galaxies gather in clusters including the Milky Way which contains millions of stars including the sun.



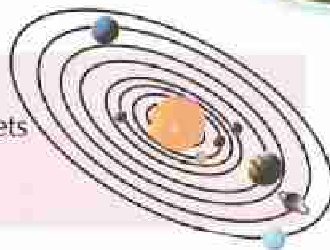
The Milky Way:

- It contains the sun and the solar system.



The solar system:

- It is the sun and eight planets revolving around it



The earth:

- The planet of life





Humans

Information

Enriching information:

- The Milky Way is given that name because it appears in the sky at night as a splashing milk or spreading straw.

The solar system

Planets revolve around the sun and the surrounding planets revolve around the centre of the galaxy (Milky Way). The sun takes about 220 million years to complete one rotation around the centre of the galaxy. The solar system is located in one of the spiral arms of the Milky Way on the edge of the galaxy.



Figure (2) The position of the sun in the Milky Way

How did the universe originated?

Many scientists believe that the universe emerged from a massive explosion called the Big Bang 15000 million years ago which resulted in all forms of matter, energy, space and time. There was no one to relate what happened. But the outstanding discoveries in physics and astronomy enabled scientists to trace the history of the universe from the first second fraction of its evolution. They believe that before explosion the universe matter was a gaseous ball of high pressure and high temperature in a small volume. It is in a constant expansion. The Big Bang theory had been developed since 1933.

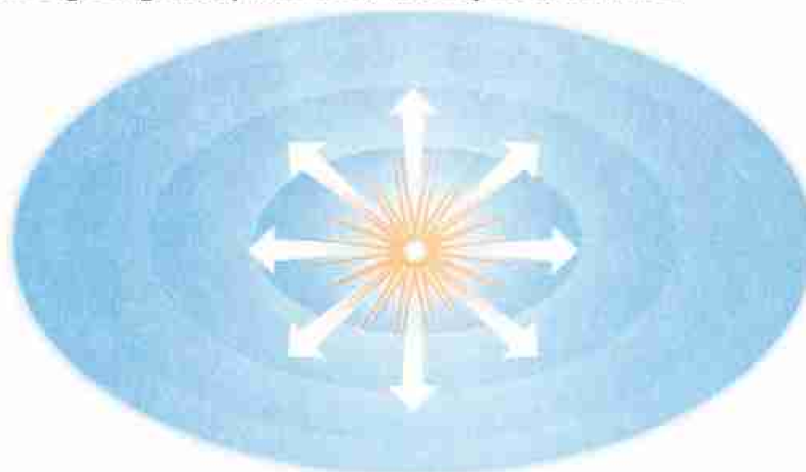
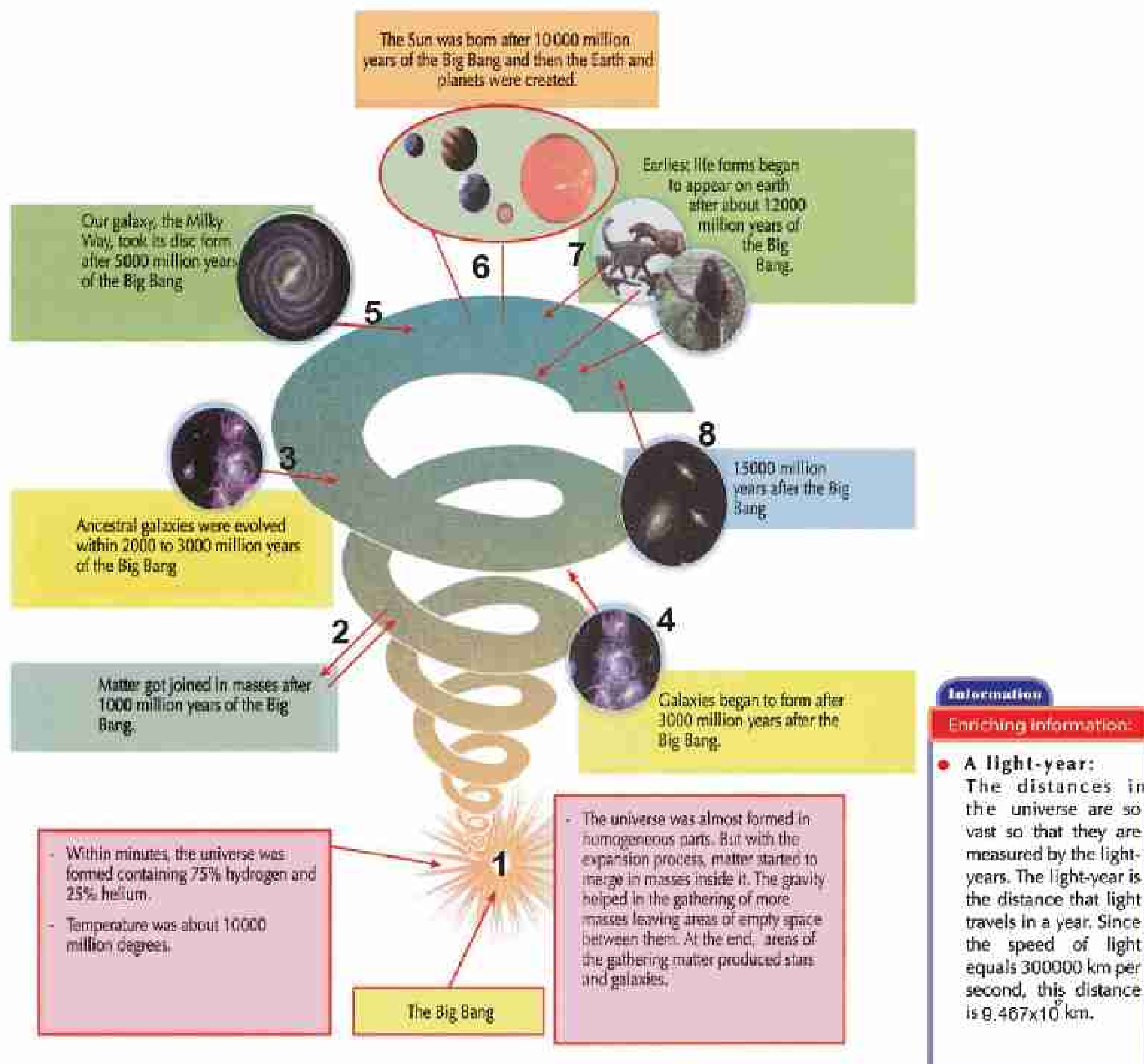


Figure (3) An imaginary shape of the big bang

The Big Bang

Since about 15000 million years, the universe was very small and very hot. Through the Big Bang, the process of expansion and changing started and it continues to this day. Within minutes of the explosion, the atomic particles merged together producing helium and hydrogen which over the years produced galaxies, stars and the universe as we know it today.



Information

Enriching information:

- **A light-year:** The distances in the universe are so vast so that they are measured by the light-years. The light-year is the distance that light travels in a year. Since the speed of light equals 300000 km per second, this distance is 9.467×10^{12} km.



Expansion of the universe and distances of galaxies

Tools:

Some water - some flour - some raisin - glass container - some of the bread yeast.

Steps: cooperate with a group of your colleagues to perform this activity

1. Bring some flour and mix it with some water and some of the bread yeast.
2. Mix the ingredients well to make bread dough.
3. Insert some raisins in the dough.
4. Leave the dough to ferment in a warm environment.



▲ Figure (5) distance of galaxies in the universe looks like distance of the raisins in the dough during its fermentation

What do you abserve?

....

What does the continuous swelling of the dough look like?

....

What does the distance of the raisins represent?

....

What do you conclude of the distances between the raisins?

....

The universe is in continuous expansion due to the movement of galaxies apart.

Information

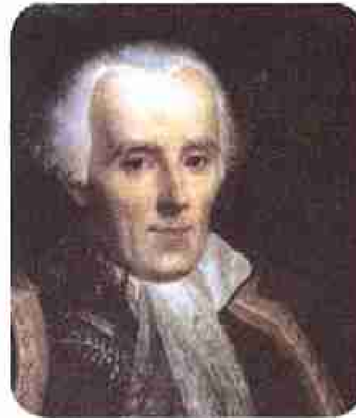
Enriching information:

- In 1964, scientists coincidently discovered radio waves coming from space. They concluded that these waves are a type of the echo coming from the Big Bang. T.V sets can receive such signals on the Earth. For more information, log on the internet.



Theories about the evolution of the solar system

There are many scientific and philosophical theories about the evolution of the solar system. They are about twenty theories and they (as we shall see) are still unproved and subject to change. We will review the most important of these theories to recognize the evolution of scientific ideas about the evolution of the solar system.



▲ Figure (8): The French scientist Pierre Simon Laplace

1 Nebular assumption (Laplace 1796)

The French scientist Pierre Simon Laplace published a research entitled " world order " and that was in 1796. This research included a vision of Laplace about the evolution of the solar system. This perception (which won great reputation for a century) has been affected by two observations, which are:

- There is something that looks like clouds or nebula in the space.
- The space contains many cloudy rings surrounding some planets such as the rings of Saturn.

Information

Enriching information:

- Gravity keeps planets in their orbits around the sun and moons in their orbits around planets. The effect of gravity decreases with increasing distance, when the planet moves away from the sun the gravity decreases and its movement becomes slower.

This theory suggested that the solar system developed as the following:

- The solar system was a glowing gaseous sphere revolving around itself. This sphere is called nebula. Over the time, the nebula gradually lost its heat so its size contracted and its revolving speed around itself increased.
- Under the effect of centrifugal force, the nebula lost its sphere form and became in a form of a flat rotating disk. Parts got separated from it by the effect of the centrifugal force to form gaseous rings that also rotate in the same direction in which the nebula rotates.
- These gaseous rings were formed after the planets of the solar system got cooled and frozen. The flaming mass that remained in the centre formed the sun.



▶ The first phase of the nebula (a gaseous sphere)

▼ The second phase (gaseous rings)



▼ The third phase (the formation of the solar system)

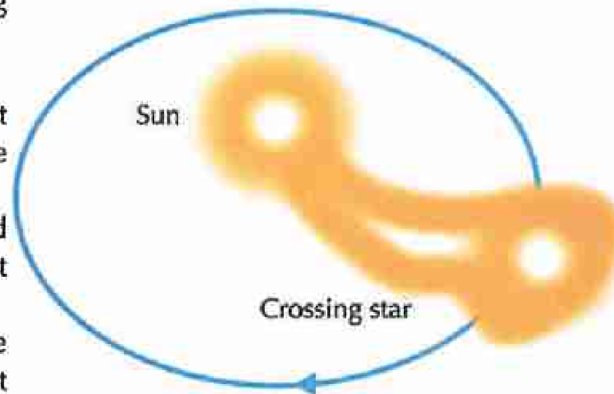


▲ Figure (9): Laplace's conception about the evolution of the solar system

❷ The crossing star theory (Chamberlain and Molten 1905)

The crossing star theory is based on some assumptions:

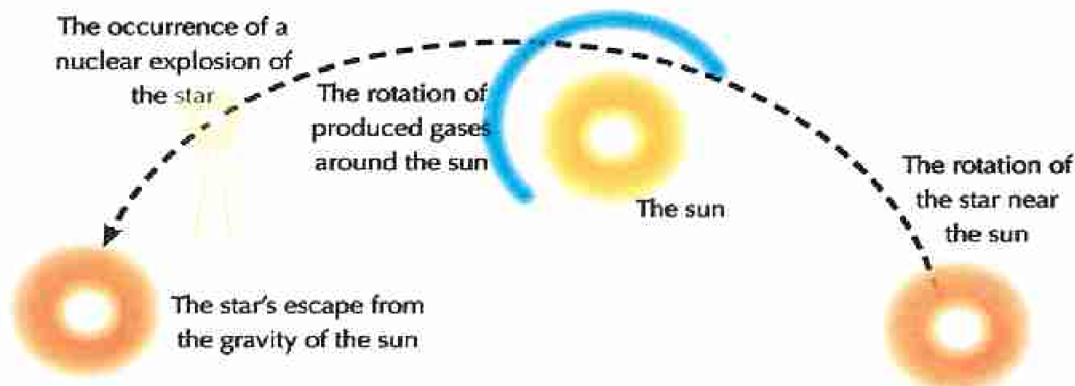
- The solar system was originally a big star which is the sun.
- Another huge star approached the sun.
- This star attracted the sun to it; an act which led to a great expansion in the part of the sun facing it.
- This expanded part was exploded and a gaseous line was formed of a great length from the sun to the last planet.
- The gaseous line started to condense due to the attraction forces and then it cooled forming the planets.
- The sun escaped from the gravity of that star due to the explosion.



▲ Fig (10): The crossing star theory

❸ The modern theory of the world (Fred Hoyle, 1944)

This theory is based on what is sometimes seen when a star glows for a short time to be one of the most shining stars in the sky. After a day or two, its glow disappears gradually to return as it was. The reason for that glowing is not precisely known. It may be due to the explosion of the star as a result of nuclear reactions that occur so suddenly and violently that the star bombs huge amounts of gaseous materials. Then, its size increases and accordingly its shining increases as well. When the bombed gases are cooled, its shining returns as it was.



▲ Figure (11): The modern theory of the world

Fred Hoyle used this fact to develop his conception and assumptions about evolution of the solar system. He assumed:

- The existence of a star rotating near the sun.
- The Star was exposed to explosion due to huge nuclear reactions.
- The force of the explosion led to the bombing of the stat's nucleus away from the gravity of the sun.
- A cloud of gas remained and was subject to cooling and contraction processes forming planets.
- the force of the sun's attraction controlled the orbits of planets around it.
- Planets which the force of the sun controlled the determination of their orbits were evolved.



Science, Technology and Society

A technological application

The solar telescope

Astronomers use special equipment centered on Earth or carried into space in order to study the sun. The sunlight is gathered then separated by the spectrometer into a solar spectrum (shows the different light wavey lengths emitted by the sun).

It is worth mentioning that astronomers got most of their information about the sun from the study of its spectrums.

This type of telescope works on reflecting the sun rays downward to a mirror in a tunnel under the Earth's surface. A picture of the sun is formed in a monitoring room where astronomers can study its light.





The Hubble telescope



The Hubble telespe was launched in April in 1990 in an orbit around the earth at a height of 500 Km. from its location it was collecting photos for locations and events took place millions of years ago These photos allow astronomers an opportunit to study the evolution of the universe after the Big Bang.

Lesson 1 exercises

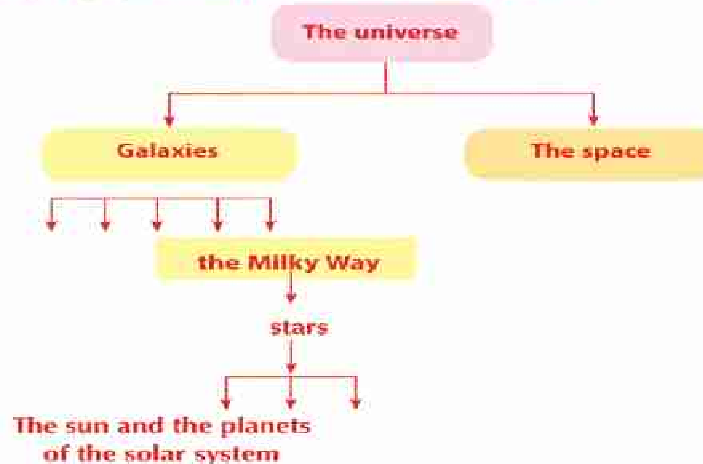
1 Write the Scientific term for each of the following:

- a) It contains all the galaxies, stars,- planets and living organisms.
- b) It contains all the stars we see at night in the sky.
- c) It is located in one of the spiral arms of the Milky Way.
- d) The expansion of the universe and the merging of atomic particles creating helium and hydrogen.

2 Put a(✔) or (✗) in front of the following sentences and correct the false ones:

- a) The solar system is located in the Milky Way. ( )
- b) The universe emerged from the particles of oxygen and nitrogen. ( )
- c) The solar system contains many stars. ( )
- d) Galaxies emerged from the Big Bang. ( )

3 Write a paragraph about each of the following terms:



4 Write the scientific term that corresponds each of the following statements:

- a) The biggest star that can be seen clearly by people on Earth.
- b) Eight planets that rotate around the sun.
- c) A flat gaseous round disk that formed the solar system.

5 Write what you know about :
The nebula – the crossing star

6 Put a (✔) or (✗) in front of the following statements and correct the false ones:

- a) The crossing star is the largest that can be seen form the surface of the earth. ( )
- b) Nine planets rotate around the sun. ( )

Unit 3 Exercises

1 **Put a(✓) or (✗) in front of the following sentences and correct the false ones:**

- a) The solar system is located at the edge of the Milky Way. ( )
- b) Each group of stars is gathered in the solar system. ( )
- c) The universe contains various galaxies that move away from each other. ( )
- d) Eight planets including the Earth rotate around the galaxy. ( )
- e) Galaxies rotate in a system around the centre of the universe. ( )
- f) Galaxies move away in the cosmic space. ( )

2 **Give reasons for each the following:**

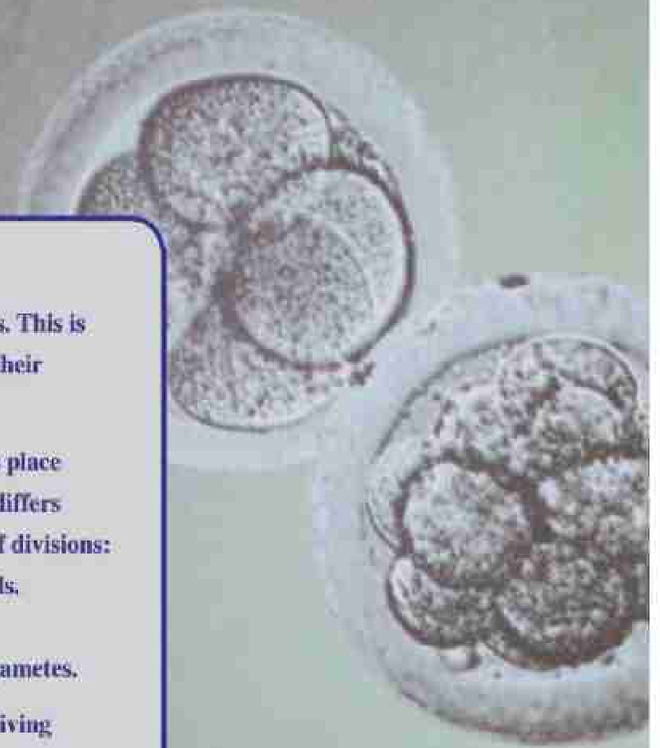
- a) The continuous expansion of space.
- b) Galaxies move away from each other.

3 **Write a paragraph illustrates each of the following:**

- a) The crossing star theory.
- b) The nebula.
- c) The cosmic space.
- d) The galaxy.
- e) The solar system.

The first term - Unit Four

Reproduction and Species Continuity



Introduction

The reason behind creation is the continuity of species. This is to keep the living organisms from extinction and ensure their interaction with environment.

This occurs through reproduction that basically takes place through the continual divisions of cells. Cellular divison differs among different living organisms. It includes two types of divisions:

- ✓ Mitosis that aims to increase the number of cells.
- ✓ Meiosis that aims to decrease the number of chromosomes to half during the formation of gametes.

Reproduction is classified according to the species of living organisms: simple living organisms are divided asexually to produce offspring identical to parents, whereas other complex living organisms reproduce sexually sexual reproducation are a source of genetic variation.

UNIT OBJECTIVES

By the end of this unit, you should be able to:

- ✔ Identify chromosomes and their role in cell division.
- ✔ Trace phases of mitosis and illustrates its importance.
- ✔ Trace phases of meiosis and illustrate its importance.
- ✔ Compare between mitosis and meiosis.
- ✔ Identify the concept of asexual reproduction.
- ✔ Identify that asexual reproduction produces offspring identical to parents.
- ✔ Identify the concept of sexual reproduction.
- ✔ Conclude that sexual reproduction is a source of genetic change.

Included issues

- Over - population.
- Health.



Lesson 1
Cell division



Lesson 2
Asexual and sexual reproduction

Lesson 1

Cell Division



Lesson objectives

By the end of this lesson, students should be able to:

- ✔ Identify chromosomes and their role in cell division.
- ✔ Trace phases of mitosis division and illustrate its importance.
- ✔ Trace phases of meiosis and illustrate its importance.
- ✔ Compare between mitosis and meiosis.
- ✔ Appreciate the importance of meiosis in reproduction of arganisms.



Lesson terms

- Chromosomes.
- Mitosis.
- Meiosis.

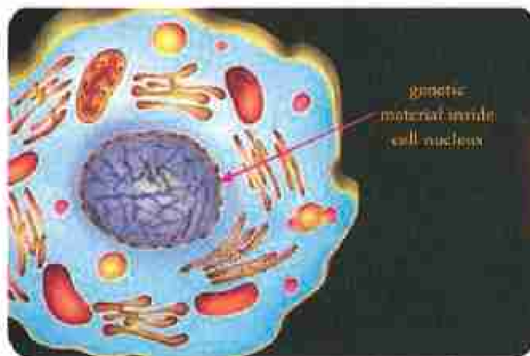
What is the importance of cell division process to living organisms?

Multicellular organism's bodies contain two types of cells: somatic cells and reproductive cells. Each type is divided in a special way.

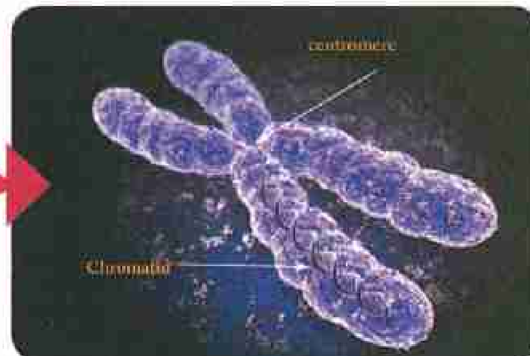
- Somatic cells are divided by **mitosis** which leads to the growth of living organisms and compensation of the damaged cells.
- Reproductive cells are divided by meiosis which leads to the formation of gametes (male and female gametes) which are responsible for reproduction in living organisms and the transfer of genetic traits from parents to their offspring.

Which part of the cell is responsible for cellular division?

The cell nucleus contains the genetic material of the living organism. This genetic material consists of a number of chromosomes, which have the main role in cell division.



▲ Figure (1): The cell



▲ Figure (2): A chromosome

General structure of the chromosome :

Notice the figure above to see that the chromosome consists of two connected threads at the centromere. Each thread is called chromatid. The chromosome chemically consists of nuclear acid called DNA and protein. The DNA carries the genetic information of the organism.

Information

Enriching information:

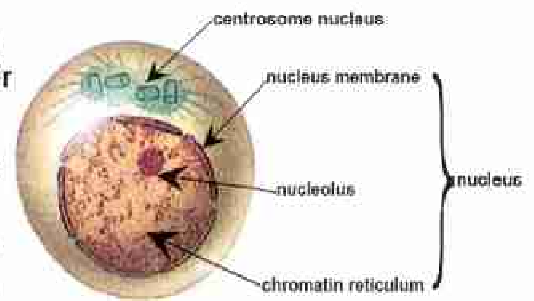
- The number of chromosomes in living organisms is different from one species to another but fixed in members of the same species. Somatic cells in most living organisms contain two sets of chromosomes (one inherited from the father and the other inherited from the mother) known as the diploid number (2N), while the gametes (male gametes (sperms) female gametes (ova) contain the haploid number (N). Knowing the number of chromosomes helps in determining the animal and plant species.

First: Mitotic division

Did you ever wonder: How does your body grow? How does the seed grow? How do the roots, stems and leaves grow?

Mitosis occurs in the somatic cells of organisms. It leads to the growth of the living organisms and compensation of their damaged cells.

Before studying the phases of this division, you must understand that before starting division the cell passes through a phase where some important biological processes occur to prepare the cell for division. This phase is called **interphase** in which the amount of DNA (the genetic material) duplicates.



▲ Figure (3): Interphase

Then the cell enters into the mitosis which takes place through the following four phases:

❶ Prophase

Observe their figure that shows the:

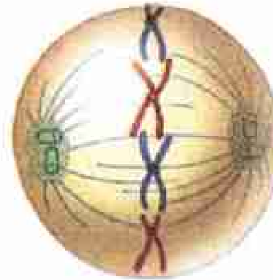
- Chromatin reticulum condenses and appears in the form of long, thin and double strings (chromosomes).
- A network of filamentous fibres called a spindle is composed and extend between the two poles of the cell.
- The spindle fibres in the animal cell is formed from the centrosome.
- In the plant cell, the spindle is composed from the cytoplasm at the cell poles.
- Each chromosome is connected with one of the spindle fibres by the centromere.
- At the end of this phase, the nucleolus and nuclear membrane disappear.



▲ Figure (4): Prophase

❷ Metaphase :

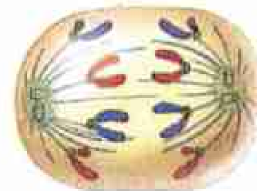
- In this phase, chromosomes are arranged along the cell equator where each chromosome is attached with one of the spindle fibers at its centromere.

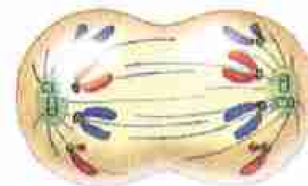


▲ Figure (5): Metaphase

❸ Anaphase:

- the Centromere of each chromosome splits lengthwise into two halves. Chromatids in each chromosome become a part from each other and separate
- Spindle fibers begin to shrink , so two identical groups of chromatids are formed. Each group migrates towards one of the cell's poles.

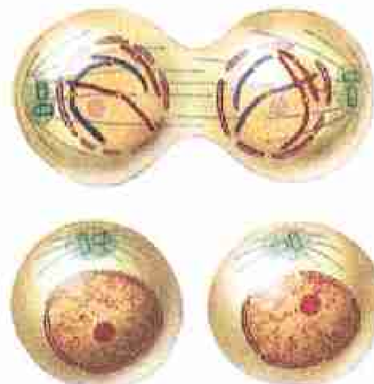




▲ Figure (6): Anaphase

❹ Telophase:

- In this phase, a series of adverse changes occur which lead to the formation of a complete set of chromosomes that have the same number of the mother cell's chromosomes. Nuclear threads, a nuclear network and then two new spearate cells are formed. Each cell has the same number of chromosomes of the mother cell (2n).



▲ Figure (7): Telophase

Second: Meiotic division

How the sperms and ova in humans and animals are formed? And how pollen grains and ovules in flowering plants are created?

Meiosis occurs in living organisms that reproduce by gametes. In humans and animals, this division occurs in the testis to produce the male gametes (sperms) and in the ovary to form the female gametes (ova). Similarly, in flowering plants this division occurs in **the anther** to produce the pollen grains and in the flower's ovary to form an ovum.


Fig (8): Interphase I

Meiosis is different from **mitosis** in that each produced cell contains half the number of chromosomes of the parent cell. This reduction occurs by the meiosis in two successive stages where the chromosomes are doubled once in the interphase that takes place before the beginning of the first meiotic division.

First meiotic division

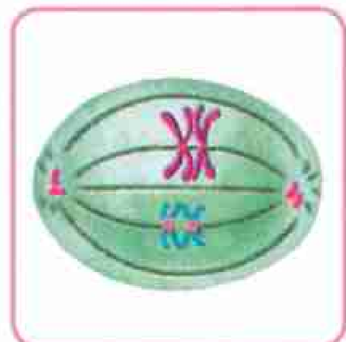
1 Prophase I:

- Chromatin reticulum intensifies and appears in form of distinct chromosomes, then chromosomes are arranged in homologous pairs, each pair consists of 4 chromatids and called a tetrad.
- At the end of the prophase 1, nuclear membrane disappears and every two homologous chromosomes (in the tetrad) start to move away from each other. Each chromosome consists of two chromatids linked together by the centromere. The spindle appears and the chremesomes get connected with spindle fiber.


Fig (9): Prophase I

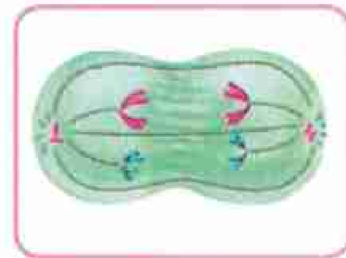
2 Metaphase I:

- In this phase, chromosomes pairs arrange on the cell's equator.


Fig (10): Metaphase I

3 Anaphase I :

- In this phase every two homologous chromosomes move away from each other as the spindle fibers shrink. One of the two chromosomes migrates towards a cell pole and the other migrates towards the other pole. Each pole contains half the number of chromosomes of the parent cell.



▲ Figure (11): Anaphase I

4 Telophase I:

- In this phase, at each of cell's poles a nuclear membrane is formed around the chromosomes. So, there are two nuclei. Each one has half the original number of chromosomes of the parent cell. Then the cell enters into the second meiotic division.



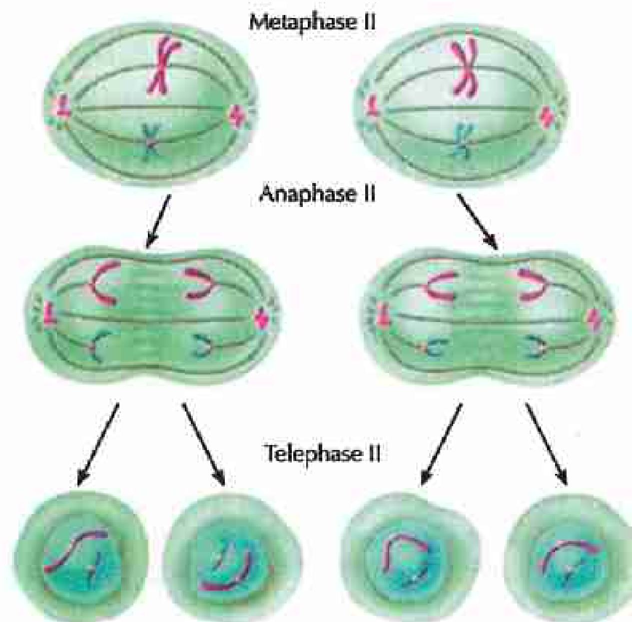
▲ Figure (12): Telophase I

Second meiotic division:

It aims to increase the number of produced cells. Each cell is called the (gamete), containing half the number of species chromosomes.

Each cell of the two cells which resulted from the first meiotic division is divided in a way similar to mitosis division phases. In the final phase (telophase II) of this division, four cells are produced and each of them contains half the number of chromosomes of the parent cell.

When male gamete combines with female gamete, the zygote is formed. It contains the original number of the organism's chromosomes. Thus, the number of chromosomes remains constant in the cells of individuals of the same species.



▲ Figure (13): Second meiotic division

The crossing over phenomenon

- At the end of prophase I, some pieces of the two inner chromatids of each tetrad are exchanged to produce new genetic arrangements. This process is called the crossing over phenoemon.

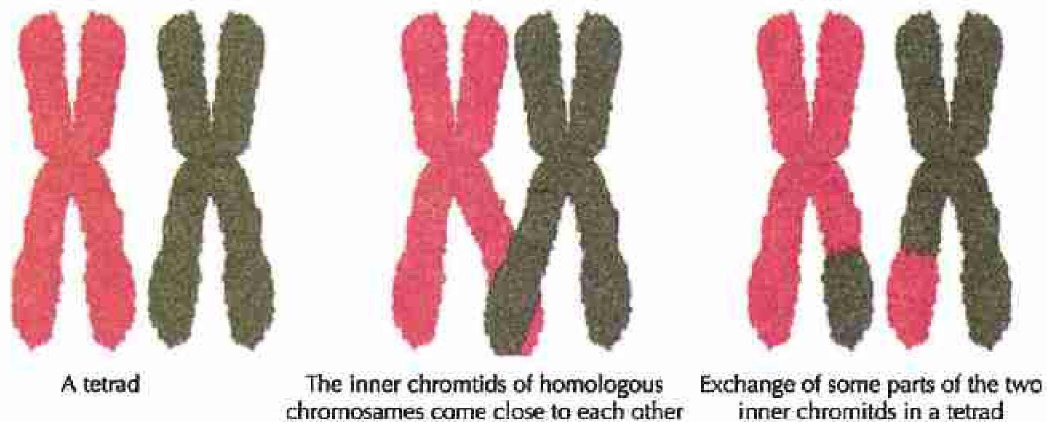


Figure (14): The crossing over phenomenon

What is the importance of the crossing over phenomenon?

- It contributes in genes (that carry genetic traits) exchanging between the two homologous chromosome's chromatids and distributing them randomly in the gametes. This is an important factor for the variation of genetic traits among the individuals of the same species.

Lesson 1 exercises

1 **Put a(✔) or (✗) in front of the following sentences and correct the false ones:**

- (a) Meiotic division occurs in somatic cells.
- (b) Meioticdivision produces cells that contain half of the genetic material.
- (c) The crossing over phenomenon occurs in the anaphase of first meiosis.
- (d) Meiotic division aims to production of the gametes.

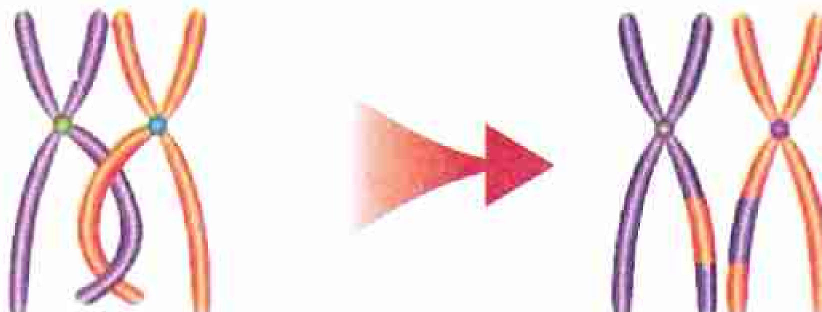
2 **The following microscopic images illustrate the first meiotic division phases:**

- (a) Identify each phase.
- (b) Arrange these phases according to the periority of occurrence.



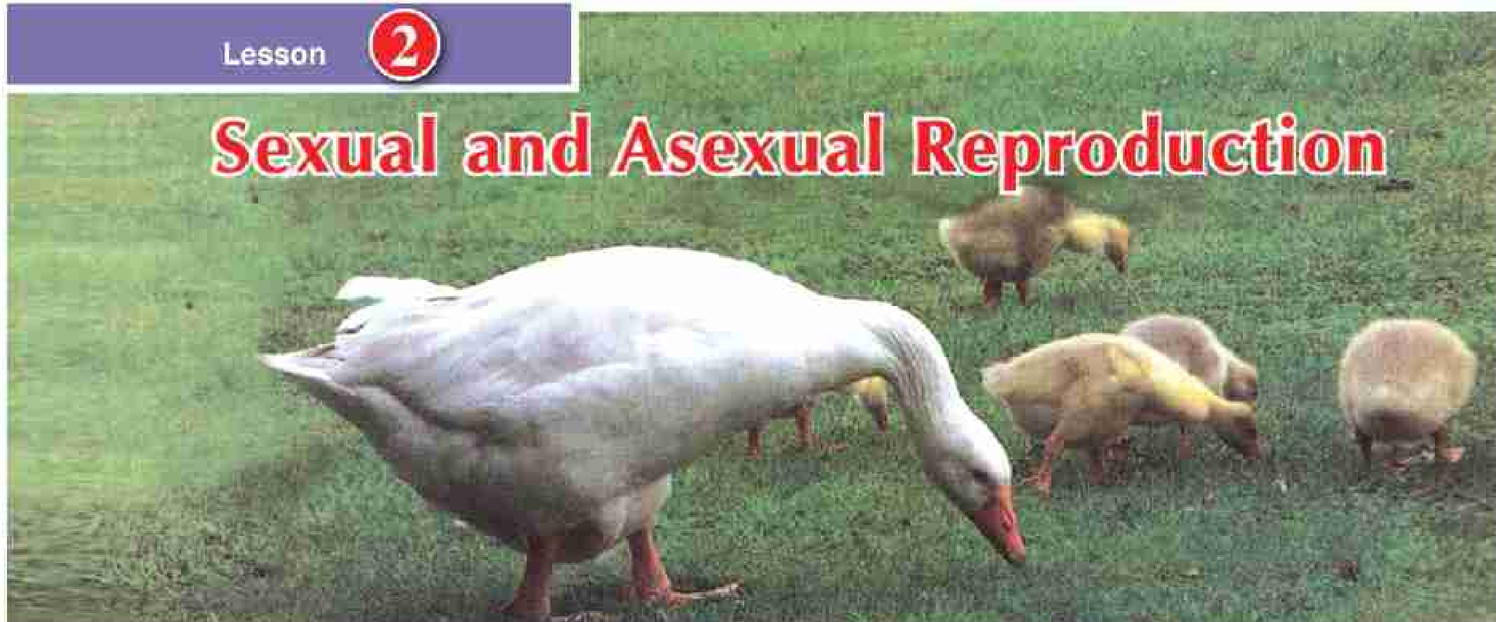
3 **Compare between meiosis and mitosis in accordance to:**
The purpose of the division - site of occurrence – division phases – division results

4 **Explain the following phenomenon and state what is its importance.**



Lesson 2

Sexual and Asexual Reproduction





Lesson objectives

By the end of this lesson, students should be able to:

- Identify the concept of asexual reproduction.
- Identify that asexual reproduction produces offspring identical to parents.
- Identify the concept of sexual reproduction.
- Identify that sexual reproduction is the source of genetic change.



Lesson terms

- Asexual reproduction.
- Binary fission propagation
- Budding.
- Regeneration.
- Spore.
- Vegetative propagation.
- Sexual reproduction.

Living organisms are characterized by their ability to reproduce. Reproduction is a biological process where the living organism produces new individuals of the same kind and thus, ensuring its continuity. In this process, the genetic traits move from parents to offspring.

Types of reproduction in living organisms:

1 Asexual reproduction:

- Asexual reproduction occurs by only one living organism. It mostly occurs in single-celled living organisms such as budding in a yeast and binary fission in Amoeba.

2 Sexual reproduction

- Sexual reproduction occurs in most higher living organisms of plants and animals. It occurs through two living organisms, one of them is a male and the other is a female.

First: Asexual reproduction

Asexual reproduction usually occurs in unicellular living organisms and also occurs in some multicellular animals and plants; where a living organism produces new individuals that have genetic traits identical to the parents. Asexual reproduction includes **mitosis** and does not require special systems or structures in the living organism. The following are some types of asexual reproduction.

Types of asexual reproduction

1 Binary fission

- It is a type of the asexual reproduction that occurs in unicellular living organisms. The nucleus is divided by **mitosis** and then the cell which represents the body of the unicellular organism splits into two cells each one becomes a new individual.
- This type of division occurs in unicellular protozoans such as Amoeba, Paramecium and Euglena and also in simple algae and bacteria.

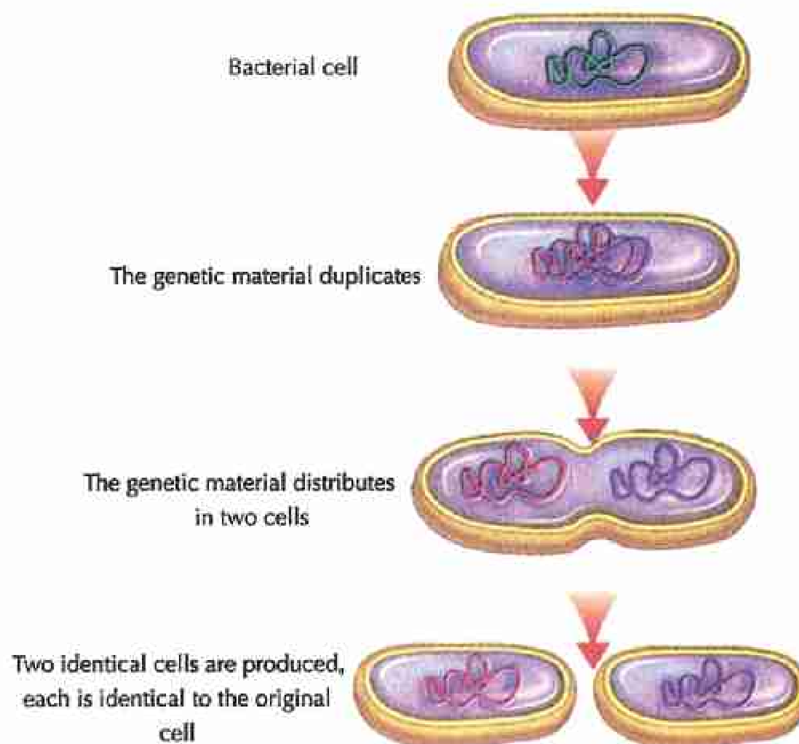


Figure (15): Reproduction by binary fission in bacteria

❷ Budding :

It is one of the asexual reproduction types that occurs in unicellular living organisms (such as yeast fungus) and multi-cellular organisms (such as Hydra and Sponges)



Discover how does yeast fungus reproduce.

Materials and tools :

A piece of yeast - sugar solution- warm water - microscope - a glass slide -cover slips – a teeth stick).



▲ Figure (16): Budding in the yeast

Procedures:

1. Add 1 ml sugar solution and 4 ml of warm water to 2 ml yeast in a plate and leave them for ten minutes in a warm dark place.
2. Take some of the mixture and place it on a glass slide. Place the cover slip gently.
3. Examine the slide under the microscope and record what do you observe.
4. Compare what do you observe with the opposite figure.

In the previous activity, you observe the following:

- In yeast, the bud emerges as a lateral bulge in the cell, then the cell nucleus is divided (by mitosis) into two nucleoli. One of them remains in the parental cell and the other immigrates to the bud.
- A bud grows gradually and remains connected to the parental cell until it is fully grown then separates from it or remains to form a colony.

3 Regeneration :

- Regeneration is the ability of animals to compensate their missing parts. The living organism can reproduce by one of its parts. Starfish arms could be regenerated and give out a complete animal if they contain a part of the central disc of the animal.



▲ Figure (17) Starfish with many arms arises from a central disc part

Question for thinking

- If the number of chromosomes in a starfish mother cell is (2N), how many chromosomes are there in the cells resulted by regeneration? Why?

4 Sporogony(Spore propagation)

- It is a type of asexual reproduction which is more common in some fungi such as bread mould, mushroom and some algae, where they have special organs called sporangia (a singular sporangium). Each sporangium has a large number of spores that release after rupturing its wall. When spores find a suitable environment, they start growing to give out a new organism.



▲ Figure (18): Release of spores from the sporangium of bread mould fungus.

5 Vegetative (reproduction)

- You already studied that plants reproduce vegetatively without needing seeds by their vegetative organs such as leaves, roots and stems, and the cells (tissues culturing) in order to produce new plants very similar to the parent plant. Vegetative propagation in plants includes cell's mitotic division.

From the above, you see that the asexual reproduction produces offspring identical to their parents.

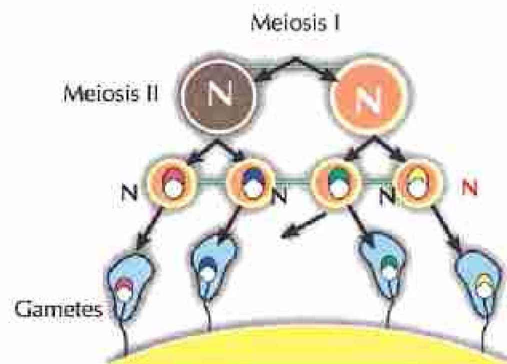
Asexual reproduction in living organisms produces individuals identical in genetic structure with the original organism. The similarity in the genetic structure of the resulted offspring is caused by (mitosis). The new offspring gets a full copy of the parental individual's genetic traits. Thus, no genetic variations occurred causing difference in the resulting offspring from the original organism.

Second: Sexual reproduction

It is the most common type of reproduction especially in the higher living organisms. Sexual reproduction occurs between two parental individuals. One of them is a male and the other is a female. Sexual reproduction depends on two main processes: formation of gametes and fertilization.

Formation of gametes

- Gametes in organisms are formed of cells known as reproductive cells by the meiotic division (reduction division). Gametes resulted from this division contain half the number of chromosomes (N) of organism's somatic cells.



▲ Fig (19): Meiosis and gametes formation

Fertilization : (Fig 20)

- It means the combination of the male gamete (N) and female gamete (N) to form a zygote (2N) which contains the normal number of chromosomes of the organism. This zygote contains genetic material from each parent. When it grows, it gives a new offspring whose traits combine each parent's traits.

Sexual reproduction is a source of genetic variation:

- The offspring resulting from sexual reproduction get the genetic traits from two sources; one of them is the male parent and the other is the female parent. This means that the resulted offspring have new genetic traits that combine the parent's traits. Thus, sexual reproduction is a source of genetic variation.



▲ Fig (20): Sperms surround the ovum before fertilization

Lesson 2 exercises

1 Compare between sexual reproduction and asexual reproduction in terms of the genetic traits of the resulted offspring..

2 Write the scientific term for each of the following:

a) It is a process where the organism produces new individuals of genetic traits identical to parents.
b) It is the ability of some animals to compensate the missing parts.
c) It consists in living organisms of cells known as reproductive cells through meiosis.
d) It contains genetic material from each parent. When it grows, it gives a new affspring whose traits combine each parent's traits

3 Put a(✔) or (✘) in front of the following sentences and correct the false ones:

a) The offspring resulted from the asexual reproduction has traits different from the original organism. ( )
b) Sexual reproduction maintains the genetic structure of the living organisms. ( )
c) Amoeba is divided by the binary fission into two identical cells; each is similar to the parental cell. ( )
d) A bud emerges as lateral bulge in the cell then the cell nucleus divides meiotically into two nuclei; one of them remains in the parental cell and the other one immigrates to the bud. ( )

4 Sexual reproduction is a source of genetic variation... explain.

5 Explain by drawing, How are gametes produced by sex cells through the meiotic division?



Science, Technology and Society

Technological application

Nanotechnology and cancer treatment

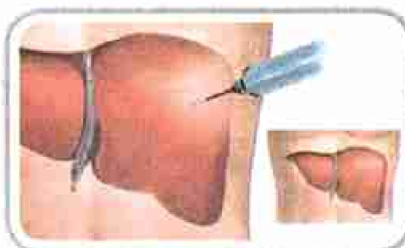
- Cancer occurs when the body cells are divided continually without controlling. The mass resulted from this division is called the tumor. Using nanotechnology, scientists have developed smart microscopic bombs that penetrate the cancer cells and explode them from the inside. They were used to kill the cancer cells in an experimental mice. Mice suffered from cancer were able to live 300 days after this treatment. As for mice that did not receive treatment, they did not live more than 43 days.



- The Egyptian scientist Dr. Mustafa El Said discovered a way to detect the cancer cells. This technical starts by loading proteins (they have the ability to attach to the cancerous cell secretions) with NANO- molecules of gold and then injecting them into the patient. The infected cell surface proteins get intertwined with the golden molecules to make it possible to monitor the infected cells through a microscope; each cell separately.
- The method of treatment is focusing laser with a certain degree to the gold molecules. Then it absorbs the light and converts it into heat which leads to burn and kill the infected cells that has stuck to them.

Technological application

Liver Transplantation



- Some cells in the human body are not divided at all such as nerve cells and red blood cells. Some cells are not divided in normal conditions but they retain the ability to divide under certain circumstances such as liver cells. For example, if the liver gets injured or a part of it is cut, the remaining cells undergo division so as to compensate the missing part. This is the scientific basis used in liver transplantation.

Unit 4 Exercises

1 **Put a(✓) or (✗) in front of the following sentences and correct the false ones:**

- **a** Somatic cells are divided by meiosis division which leads to the growth of living organisms and compensation of the damaged cells.
- **b** Reproductive cells are divided by mitosis which leads to the formation of gametes
- **c** Chromatin reticulum condenses and appears in the form of long, thin and double strings (chromosomes) in the telophase of the mitosis division.
- **d** Meiosis results in the formation of two cells; each contains half the genetic material of the parental cell.
- **e** The asexual reproduction produces living organisms similar in their genetic structure.
- **f** Gametes in living organisms are produced by special cells known as the somatic cells during the meiotic division.

2 **Write the scientific terms for each of the following statements:**

- **a** A phase in which some important vital processes occur to prepare the cell for division and the genetic material in the cell is doubled.

b) A phase in which the chromosomes migrate towards the cell equator where each chromosome is connected with one of the spindle fibers at the centromere.

c) A phase where some processes occur upon which the formation of chromosomes that equal in numbers with the parental cell take place.

d) It contributes in genes exchanging between the chromosome's chromatids and distributing them in the gametes.

e) A cell division that occurs in the somatic cells and results in the growth of the living organism.

f) A type of the asexual reproduction that occurs in unicellular living organisms, in which the nucleus is mitotically divided (mitosis) and then the cell which represents the body of the unicellular organism splits into two cells.

3 **Explain how sperms and ova are formed in the human being?**

4 **Explain using drawing the crossing over phenomenon and its role in the variation of genetic traits among members of the same species.**

Unit 4 Exercises

5 Clarify the importance of each of the following:

a) The meiotic division in keeping the number of chromosomes constant in the same species.

b) The sexual reproduction in the occurrence of the genetic variation.

c) The asexual reproduction in producing offspring identical to their parents.

6 What is the relation between the genetic structure for each of offspring and parents in the following cases and give the reason:

a) Binary fission in paramecium.

b) The plant resulted from germination of seeds.

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